

ARCHIVES OF OTOTOLOGY.

ON BACTERIAL INVASION OF THE INNER EAR IN THE COURSE OF DIPHTHERIA.¹

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With 12 illustrations—Plates i.-v.—and 4 temperature charts—Plates vi.-xi.

IN the following pages I submit to my colleagues the first observations upon the direct emigration of a pathogenic micro-organism into the tissues of the membranous and osseous labyrinth and the pyramid of the petrous bone. Three years ago I described (in vol. xii., page 255 of these ARCHIVES), in collaboration with Dr. Steinbrügge, the histological appearances of six temporal bones derived from three children who had died in the hospital at Hamburg of simple diphtheria. Changes were noticed in the external ear-canal, the membrana tympani, the handle of the malleus, the mucous membrane of the tympanum, and the annexa of the tympanic cavity. The labyrinth showed nothing abnormal. The only noteworthy discovery was coagulation of the lymph, which was observed in most of the specimens. As far as the abnormalities of the middle ear were concerned, we concluded that they were caused by a light form of diphtheria. I was, however, not satisfied with the outcome of the investigations, for I had noticed during a number of years, and in a series of cases, such severe and peculiar disturbances of hearing following diphtheria, that I was led to think the seat of the disturbances must be in the labyrinth. I have therefore taken up this theme anew in order to investigate these conjectured changes

¹ Read in part, with demonstration of the micro-organism, before the Medical Society of Heidelberg, December, 1886.

in the labyrinth. I have used for my observations six temporal bones of three children who died of diphtheria. The specimens were sent me by friends, accompanied by very scanty notes.

Methods of Examination.

The petrous bones were laid in Müller's fluid. After inspection of the internal and middle ear, the pyramids were detached and decalcified with chromic acid, using first $\frac{1}{8}\%$, then $\frac{1}{4}\%$, and lastly a $\frac{1}{2}\%$ solution, to which a 2% solution of nitric acid was added; they were then washed out for several hours in running water and preserved in absolute alcohol, imbedded in celloidin, and the sections made in the usual manner, each section being first laid in glycerine and then examined. The transverse and longitudinal sections for bacterial examination were subjected to the staining method of Gram, keeping the specimens in either glycerine or xylolcanada balsam—the latter procedure is the only reliable one). For the inspection of the bacteria themselves I used a condenser and a Hartnack oil-immersion lens, $\frac{1}{12}$ inch in diameter.

CASE 1.—These two bones were taken from a three-year-old child with diphtheria, upon whom tracheotomy was performed the day of its reception into the hospital.

Autopsy: Faucial and laryngeal diphtheria.

Right petrous bone (No. 1). External and middle ear. External ear canal free. *Mt* turbid, sunken, and yellowish. The neighborhood of the ostium pharyng., tympanum, fenestra, and adjoining air spaces, filled with a jelly-like exudation, composed of mucous cells and exfoliated epithelium. Mucous membrane of the middle ear and promontorium, slightly injected. Blood-vessels congested in places.

Result: No diphtheria of the middle ear. Secretory form of middle-ear inflammation.

Left petrous bone (No. 2). External and middle ear. In external ear canal are seen plates of cholesterine, epithelial cells, and pus cells. *Mt* œdematous. Epidermis thickened and grayish-red. Mucous membrane of *Mt*

very much injected. At the base of the long limb of the anvil is seen a small round carious spot surrounded by a vascular circle. Exquisite hyperæmia of the mucous membrane of the promontorium with small extravasations scattered here and there.

Result: Probably, a beginning diphtheritic process, involving the membrana tympani, the mucous membrane of the tympanum, and the base of the long process of the incus.

Right Labyrinth (No. 1).

Section parallel to the long axis of the petrous bone. On the surface of the auditory nerve a few extravasations. Cochlea normal in every respect. Facial nerve intact. No signs of pus anywhere.

Changes in the semicircular canals and ampullæ. Horizontal and frontal canals with their ampullæ unchanged. At the lower end of the median limb of the sagittal semicircular canal, a mass is seen about $\frac{1}{10}$ mm long, almost entirely filling the endolymphatic space. With the low power (see Figs. 4 and 5) the endolymphatic space is found almost filled up by an egg-shaped mass, which in one place is intimately adherent to the inner wall of the membranous canal. The epithelium is lacking at this point. Fig. 5 shows a sketch of a transverse section through the apex of the occluding mass, where it projects free into the endolymphatic space of the membranous canal.

The arrow in Fig. 4 designates the place reproduced in fig. 6, with a Hartnack $\frac{3}{8}$ lens. With this power the mass is seen to consist of coagulated lymph, of extremely fine convoluted dark threads (the separated, coagulable organic substance of the lymph), and of a number of cells, mono- and poly-nucleated, mostly, however, the latter (giant cells), some of which are free, while others are included in the coagulation. Near by are seen the periosteum of the bony canal, the ligamenta labyrinthi, and the two outer layers of the membranous canal, all more or less infiltrated with cells. The sagittal semicircular canal was not infiltrated, limpid and structureless. The thrombosis of the blood-vessels of the periosteum was quite remarkable, but there was no forma-

tion of new vessels. We have therefore before us a purely cellular pathological condition. How this is to be accounted for, will be discussed later on.

Labyrinth (No. 2).

Section parallel to the long axis of the petrous bone. Ramus cochleæ, vestibuli, and sacculi, very defective. The periosteum shows partial thrombosis of the vessels, and is thickened and frayed in some places, while normal in others. Where normal, it is infiltrated with pigment; other places show hemorrhagic infiltration.

In the light spaces the partially structureless perineurium is observed (Fig. 1, *sp*). At *ta*, Fig. 1, the débris of the twigs of the arteria auditiva interna is shown. With the higher power a large yellowish-red extravasation of blood is seen undergoing pigmentary metamorphosis. The arterial twigs are empty, and partly covered with extravasated blood. The trunks of the vestibular and cochlear nerves, the former notably, send off partially pigmented nerve bundles to the periosteum. In the meshes of these nerve twigs are seen granular cells, not, however, very numerous.

The principal nerve trunks, as well as their ganglia, are still preserved, and of normal structure. The walls and ligaments of all the vestibular structures, as well as the cristæ and maculæ, with the exception of the frontal ampulla, showed no change whatever in the nerve texture, but were infiltrated with pigment, as described above. The sheath of the facial (Fig. 1, *nf*) was also infiltrated with pigment. The walls of all the semicircular canals, and their endo- and peri-lymphatic spaces, were normal. No change in the cochlea.

CASE 2.—Eleven-year-old girl; had pharyngeal diphtheria some time before her reception. Tracheotomy as soon as admitted, with death the next day. Autopsy discovered diphtheria of the isthmus, fauces, larynx, and trachea; bilateral lobular pneumonia.

Examination of right petrous bone (No. 3) showed a catarrhal affection of the middle ear, but no signs of diphtheria.

Left petrous bone (No. 4). Stapes and its region normal.

The periosteum of the bone surrounding the fenestra rotunda is considerably thickened; bands of false membrane of fibrillar structure pass from the sides to the middle of the cell-infiltrated membrane covering the aperture, and cause it to bulge outwards. Between the interstices of the false membrane are seen coagulated fibrin and granular cells. There is also a pretty considerable extravasation of blood into the niche of the fenestra.

Result: Primary catarrh of the middle ear, complicated by diphtheria.

Right Labyrinth (No. 3).

Semicircular canals and ampullæ. The result of the histological examination in this case may be summed up briefly. The disease of the endolymphatic space of the semicircular canals extends over more territory, and the pathological cell process is in a more advanced stage than in labyrinth No. 1.

In addition to this, however, the perilymphatic space of both semicircular canals and their ampullæ, together with the ligaments and the periosteum, are also involved; this being finally complicated by necrosis of the bony semicircular canal, so that different sections show very varying conditions. The endolymphatic space of all the semicircular canals, with the exception of the superior limb of the frontal, was filled with a cellular mass, causing in some places complete, in others only partial occlusion. The mass, as far as structure is concerned, simply represents a later stage of the same condition demonstrated in labyrinth No. 1. In several portions of the specimen (see Fig. 7) cell-territories are seen encapsulated by concentrically arranged layers of connective tissue, the most extensive of which is situated in the middle of the drawing. Between these cellular tracts stretches a delicate network of spindle-shaped and spider-like corpuscles, in the meshes of which are contained cellular elements and a finely fibrillar ground-substance, with here and there an occasional blood-vessel. The periphery of the neoplasm, for the most of its extent, has coalesced with the wall of the membranous

semicircular canal. In a later stage, the proliferation of the connective tissue is much more marked (see Fig. 8), so much so that both endo- as well as peri-lymphatic spaces are completely obliterated. A still later stage of this proliferation process results in the transformation of the connective tissue of the endo- and peri-lymphatic spaces into bone (see Fig. 8, *VK*, and Fig 9). This was found in several places, notably in the lateral limb of the horizontal semicircular canal. The ossified cellular tracts (a distinct concentric lamellation was very evident in several of these) were, in some cases, situated in the centre of the mass; in others, more peripheral and nearer the bone, and still surrounded by the original cellular proliferation. The coalescence of the mass with (Fig. 9, *HL*) the periosteum is therefore not of any importance (or only exceptionally), with reference to the metamorphosis into true bony tissue.¹

Histological changes in the peri-lymphatic space, especially periosteal alteration (see Figs. 2, 7, 8, 9, and 10).—Scarcely any part of the periosteum of the semicircular canals was normal, even that bordering on the ampullæ. The ligamenta labyrinthi were infiltrated and thickened, in some places structureless and covered with the product of retrogressive metamorphosis; again they appeared thin, atrophied, and thread-like, with no trace of fibrillar structure or endothelial cells. The cellular infiltration was, as a rule, more marked near the bone, with blackening of the periosteum. Spaces present themselves at different points, caused by the breaking down of the cellular mass, penetrating more or less deeply into the indented bone (see Fig. 7, *Gw*). At other points the ligaments are atrophied, and the configuration of the canal is distorted and angular (see Fig. 8). This is also the case where the ligaments are normally absent. Cellular infiltration of the periosteum is seen, resulting in its proliferation and consequent thickening; also necrosis of the vessels and bone. Of the further changes in labyrinth No. 3, I can only emphasize those already given in Fig. 3.

¹ See Fig. 8, *VK*, for such circumscribed cellular territories. It is here seen distinctly that ossification may result from the direct transformation of the cells into bony tissue, without interposition of the periosteum.

Changes in the Aquæductus Vestibuli.

The posterior third of the canal is narrowed, owing to thickening of the periosteum, while towards the middle of the canal the periosteum is infiltrated with cells, and also shows small scattered yellow accumulations of pigment, the traces of old capillary hemorrhages.

The periosteum of the surface of the petrous bone, extending into the interior of the pyramid, was greatly changed, and bands of it could be seen with the naked eye, passing down into the bone itself. In the interior there were bone defects, upon the edges of which the periosteum was eaten away and frayed out.

This peculiar condition of the petrous bone, without the slightest trace of pus, has never been observed before. I therefore refer the reader for its explanation, to a subsequent chapter on the genesis of the observed changes.

Alterations in the Haversian Canals and Medullary Spaces of the Pyramids of the Four Preceding Petrous Bones.

Most of the Haversian canals are infiltrated with round and oval mono-nucleated cells (see Fig. 11 at *hk*). In many of the specimens the cells extend to the adjoining medullary spaces. The vessels of the canals are normal. The connective-tissue sheath bounding the marrow of the bone, much thickened and infiltrated with round and oval cells, presents itself as a broad hyperplastic vascular zone, projecting into the medullary sinus. The remaining portions of the thus changed canal was empty in places, while some of the medullary spaces showed no medullary substance whatever, or only very little. In Case No. 1 the normal medullary substance was still present in the centre of the cavity, the periphery showing only reticulated connective tissue, the meshes of which were empty, with the exception of an occasional marrow cell. In other cases it was replaced by the products of retrogressive metamorphosis, granular giant cells, and colloid corpuscles. (See Fig. 11 at *C*). According to this we have present side by side in the Haversian canals and medullary spaces, the products of both necrosis and proliferation, and we may readily in-

fer from this that the passage of micro-organisms through the Haversian canals, by irritation of the walls of the vessels, has caused an emigration of the white blood corpuscles, without leading to changes within the vessel walls themselves, whilst once arrived in the medullary substance the bacteria have produced a rapid decomposition of the tissue elements.

Left Labyrinth (No. 4).

Section perpendicular to the long axis of the petrous bone. There was considerable hemorrhage into the labyrinth. Upon inspection of the specimen with the naked eye, there was remarkable first, a round reddish-brown spot about $\frac{1}{2}$ mm in diameter, and secondly, a round cavity, surrounded by a brownish rim. Under low power the reddish-brown spot was seen to be a hemorrhagic exudation into one of the rami basillares of the cochlea, showing partial degeneration, while the brownish ring was the periosteum of the vestibule, infiltrated with blood. Evidences of previous hemorrhage, in the shape of pigmentary metamorphosis and diffuse pigmentary infiltration, were also present in the walls of the membranous utriculus, sacculus, and ampullæ. Nothing of the kind, however, was found in the semicircular canals. A fact especially worthy of notice was the implication of the periosteum of the lamina ossea of the first turn of the cochlea, where necrosis of the periosteum had led to rupture of vessels, as a result of which the greater part of the scala tympani was filled with a hemorrhagic exudation, extending into the aquæductus cochleæ.

Changes in the Acoustic Nerve and Arteria Auditiva Interna (Labyrinth No. 4).

In the neighborhood of the base of the modiolus, two cavities, about 2 mm long by 1 mm wide, were visible to the naked eye, while a smaller cavity was situated near the vestibule. Under the microscope, the periosteum was seen to be poorly supplied with vessels and very much thickened, and the cavities mentioned were devoid of nerve tissue. Along the border of the still intact nerve, on one side was seen a lacerated twig of the arteria auditiva int., while its

outer wall was covered with hemorrhagic exudation. Upon the opposite side the periosteum was thickened and partially infiltrated with blood. Towards the centre from the lacunæ, the branches of the auditiva were distended with blood in some places and torn off in others. At one of the points of laceration, was seen a reddish-yellow degenerated extravasation. The lacerated arterial twigs were empty, with opaque walls and indistinct structure. Punctate hemorrhages were also noticed between the nerve fibres. The nerve filaments of the utricle and saccule also showed signs of degeneration at the maculæ through which they enter.

Cochlea.

The hemorrhage into the scala tympani of the first turn has been mentioned above. The organ of Corti was unchanged. The inner surface of the membrane of Reissner was covered with a broad layer of coagulated lymph, through which lymph corpuscles and large mono-nucleated cells (rich in protoplasm) were dispersed; similar cells occupied the sulcus spiralis. The second and third turns showed nothing noteworthy. The facial nerve was normal.

CASE 3.—A girl five and a half years old. Received Dec. 24th, with faucial diphtheria following measles. Died Dec. 26th. The autopsy established diphtheria of the fauces, trachea, and larynx, with bilateral lobular pneumonia.

Right Petrous Bone (No. 5).

External auditory meatus free. The *Mt* is yellowish-red, and shows the characteristic appearances caused by occlusion of the Eustachian tubes. The light spot is reduced and displaced towards the periphery. Upon inflation with the Eustachian catheter, after considerable resistance is overcome, a bubbling noise is heard. Upon inspection of the *Mt* after this procedure, an exudation is seen, bounded by a line of demarcation, and made up of granular cells, exfoliated epithelium, and a few red blood corpuscles. The mucous membrane of the middle ear is very vascular, the vessels distended to their fullest extent. Near the vessels are numerous granular cells. The mucous membrane of the bony tuba is thickened and strongly injected.

Summary: Middle-ear catarrh, secretory form. No diphtheria. The catarrh must have existed before the diphtheria.

Left Petrous Bone (No. 6).

The *Mt* was pressed upon the promontory by an epidermic non-transparent membrane. Tuba accessible to a catheter (1 mm in calibre). Mucous membrane of the entire middle ear is in the same condition as that of right ear. Tympanum entirely filled up by a gelatinous exudation. Mucous membrane thickened. Promontorium very flat. Anterior and posterior pouches of the *Mt* filled with glutinous matter. The exudation in the tympanum consists of very large granular cells, exfoliated epithelium, and red blood corpuscles; some of the latter are isolated, others collected together in groups. Eustachian tube normal on microscopical examination.

Summary: The same as on the right side; no diphtheria of the middle ear.

Labyrinths 5 and 6.

Both bones, with the exception of the acoustic nerve and the median limb of the sagittal semicircular canal of bone 5 and the auditory nerve of No. 6, were destroyed by the too intense action of the decalcifying fluid. The appearance of the remaining parts, however, is well worthy of notice, owing to their analogy with what has already been described.

Labyrinth No. 5.

The acoustic nerve was surrounded by lacunæ, but there are no traces of fresh hemorrhagic exudation. The periosteum was thickened, detached in places, and covered with red blood corpuscles and the products of retrogressive metamorphosis. The remaining undestroyed nerve tissue and ganglia were normal. The changes in this case were also due to necrosis of the vessels, and the process had evidently reached its culminating point. For changes in the sagittal semicircular canal, see Fig. 10.

The perilymphatic space was partly obliterated, the endolymphatic space entirely so. The form of the canal greatly

changed and irregular. The endolymphatic space is intimately adherent to the hypertrophied ligamenta labyrinthi, and encroaches deeply upon the neighboring bone. At points where this coalescence has not taken place, the periphery of the occluding mass is seen to consist of from four to six concentric lamellæ of spindle-shaped cells lying one upon the other. The texture of the mass varies considerably, but most of the specimens show tortuous blood-vessels on a background of light intercellular substance made up of round and oval cells, with occasional pear-shaped spindle and stellate cells. One or more groups of giant cells were also noted, such as shown in labyrinth No. 3 (see Fig. 10, at *r z*). In fact, I came to the same conclusion arrived at in the case of labyrinth No. 3, namely, that these giant-cell territories were the seat of the development of the blood-vessels (see explanation of Fig. 10).

Auditory Nerve of Labyrinth No. 6.

Apertures exactly similar to those described in labyrinth No. 3 were also discovered here in the auditory nerve and ramus ampullæ frontalis. The periosteum of the porus acust. int. was greatly thickened, and detached strips one fourth *mm* wide obtained here and there, evidently the result of previous hemorrhages. The border of the periosteum shows a few pigment granules. There are also present the products of degeneration and the scanty remains of disintegrated nerve tissue, as well as the débris of the arteria auditiva. The rest of the labyrinth was destroyed by the decalcifying fluid. The medullary spaces and Haversian canals of both Nos. 5 and 6 were in the same condition as those of the other bones.

BACTERIOLOGICAL PARTS.

*Notes on the Bacteria of Diphtheria.*¹

Frederick Löffler says²: "Our present methods of staining permit of the demonstration of only two kinds of bacteria

¹ I append the above for the benefit of those of my readers who may not be thoroughly "at home" in bacteriology.

² "Mittheilungen aus dem Kaiserlichen Gesundheitsamt," vol. ii., pp. 421-429.

in diphtheria, viz.: the streptococci and bacilli, first described by Klebs. Morphologically identical streptococci are met with in various other diseases characterized by lesions of the mucous membrane; as, for instance, variola, typhus and puerperal fever, and as no one doubts the accidental co-existence of the micro-organisms in these infectious diseases, there is no reason why their presence in diphtheria may not also be interpreted as only a complication of that disease.

"This is further substantiated by the fact that the cases in which they alone are found, or in which they preponderate, are not particularly characteristic of diphtheria. Another remarkable evidence is that they are found in those cases of diphtheria complicating scarlatina, where the morbid process was confined entirely to the pharynx. In such cases we would either have to suppose a disappearance of the local changes caused by the diphtheritic poison before the case came under observation, or else incline to the view that the streptococci are capable of producing a process similar to diphtheria." So much Löffler. I myself have not observed the rod-like bacilli, and so concur with Löffler's final deduction, to the effect that the anatomical appearances are insufficient to recognize the specific significance of either of the two kinds. The experiments made by Löffler upon different animals, with the pure cultures derived from several cases of diphtheria, led him to the following inference: "Since the streptococci do not produce in any animal a disease at all similar to diphtheria, and are in the human subject present only in a limited number of cases, and since the bacilli are also found upon and in the diseased organs, and finally are seen in exactly the same arrangement in the internal organs in other infectious diseases accompanied by lesions of the mucous membrane, we are justified in concluding that they are only accidental complications of diphtheria and not its causative agent."

Heubner says the streptococci are evidently not identical with the poison which causes diphtheria of the tonsils; for otherwise every case of scarlatinal diphtheria would necessarily lead to a more malignant form. The tissue first be-

comes necrosed, owing to the unknown poison of scarlatina. The cocci then find entrance, proliferate, reach the roots of the lymph channels, pass to the glands, and although mainly retained there, finally reach the blood. Their presence in the blood, as well as in exudations in joints, etc., has been verified by the above-mentioned author. Fraenkel and Löffler have cultivated them from the tissues, and shown them to be identical with the streptococci of Rosenbach. Scarlatinal diphtheria furnishes a soil very favorable to their development. They make their appearance implanted upon the previous infection, which furnishes every condition for their further growth. Now as this organism has been proven experimentally to be highly poisonous to the animal body, the danger from this disease is materially increased by their presence. We have, however, learned from our observations of other forms of pharyngeal ulceration, that decomposition of the tissues of this region does not necessarily lead to a general septic infection. Löffler, in his investigations on scarlatinal diphtheria, first clearly explained how the infection is brought about, and his statements were speedily confirmed by a very characteristic case observed by Bahrdt and myself, more recently by Crooke, Fraenkel, and Freudenberg. Flügge,¹ on the different forms of streptococci, says: "In our consideration of the streptococci we are confronted with the remarkable fact that five micro-organisms, almost identical in microscopical appearance, and hardly to be distinguished from each other by cultivation, are extraordinarily different in their action upon animals and men." The forms mentioned are: *Streptococcus pyogenes*, *Str. erysipelatos*, *Str. pyogenes malignus*, *Str. septicus*, and *Str. articulorum*. He further says: "Löffler has observed in the different forms of diphtheria, chains of micrococci lying upon and in the mucous membrane, which probably have no etiological connection with diphtheria itself, but seem to be accidental factors, capable of giving rise to secondary complications of a local or constitutional nature. Further on: "Upon the injection of cultures, some of the chains having 100 links,

¹"Die Mikroorganismen mit besonderer Berücksichtigung der Aetiologie der Infektionskrankheiten." Von C. Flügge. Zweite Auflage, Leipzig, 1886.

into the veins of the rabbit, diseases of the joints appeared in from four to six days, filling them with pus containing streptococci, and slowly causing the death of the animal. The same joint diseases are also caused by the above-named varieties of streptococci, but here they are only partial manifestations of a rapid general infection.

Personal Observations.

The micro-organisms found by me in the labyrinth were of round or oval form, and were often disposed in rosary chains (Fig. 12). According to what has already been said, we have here an invasion of the labyrinth and pyramid of the petrous bone by streptococci; that is by micro-organisms that are only an accidental complication, and not specific of diphtheria. I found these bacilli everywhere in the medullary spaces of the petrous-bone pyramids. As is well known, the marrow of bones ranks next after the liver and spleen, as a locality for which micrococci have a great predilection.

I also found these micrococci in the endolymphatic space of the semicircular canals of petrous bone No. 1 as well as in the same space of the frontal ampulla of bone No. 3. The endolymphatic space of the semicircular canals of the same bone was completely filled with a metamorphosed proliferous mass, but no bacilli were found; neither were they present in petrous bone No. 5. A few were seen in the perilymphatic spaces of the semicircular canals of bones 1 and 3, and also in the frontal ampulla of bone 3. Negative results were obtained, on examination of the vestibule and cochlea in all cases. Alterations in the cochlea existed in only one case (hemorrhage into the first turn of the scala tympani; accumulation of lymph and large round cells in sulcus spiralis and ductus cochlearis. No bacteria were discovered in the defects in the acoustic nerve and its ramifications, except in bone No. 6. Their presence was, however, positively demonstrated in the aquæductus vestibuli and in the apertures of the proliferated and partially degenerated periosteum. It will require further investigation exactly to establish the manner in which the micro-

organisms are propagated in the different sections of the labyrinth, and to determine the relation between the topographical changes, as regards new formations and necrosis. I acknowledge that the results obtained by my present investigations are defective in this respect. In order to remedy this, I have commenced a new series of researches upon the same subject. I hope the results thus obtained will throw light upon another doubtful point, namely, the time required for the development of the described morbid condition. I could not discuss this in the present paper, because of the absence of all data concerning the duration of the disease.

*A Short Summary of the Changes Found in all the Pyramids.
Their Probable Genesis.*

The global stasis of the blood-vessels noticed in different portions of the body in diphtheria by various observers, was also found here, especially in the arteria auditiva interna. The laceration of the artery is due to vascular necrosis, caused by the micrococci present. Consecutive hemorrhages were traceable on one side, reaching into the periosteal region of the lamina spiralis ossea of the first turn of the cochlea (hemorrhage into its scala tympani); on the other side, extending to the periosteum of the vestibule, as far as its cristæ. This necrosis of the vessels, with the resulting hemorrhages, caused an extensive tissue necrosis¹ of the principal nerve tracts; hence the frequent defects, visible to the naked eye, in the domain of the auditory nerve and its ramifications. This condition corresponds to the late stages of hemorrhagic infiltration, first observed by Buhl,² at the roots of the spinal nerves and in the intervertebral ganglia after diphtheria, and is not to be confounded with the appearances noticed by P. Meyer and Mendel.³

¹ Klebs thinks the micrococci in diphtheria cause paralysis of the blood-vessels and global stasis, leading to necrosis. (See *Verhandlungen des zweiten Congresses f. innere Medicin.*)

² *Zeitschr. f. Biologie*, vol. iii., 4, 1867, p. 341.

³ In a case of exquisite diphtheritic paralysis of the phrenic nerve, Paul Meyer says: "The conditions found are those of a parenchymatous neuritis: breaking up of the medullary substance, proliferation of the nuclei of the sheath

In the remaining pyramidal regions, nekrobiotic conditions co-existed with the phenomena of proliferation, and not infrequently side by side with each other.

The Haversian canals and the periphery bounding the marrow spaces were the seat of cellular infiltration, with hyperplasia of the sheath of the medullary substance, while the medullary substance itself was found disintegrated and filled with the products of retrogressive metamorphosis. Robert Koch¹ remarks: "As soon as bacteria or other micro-organisms are met with in quantity in the interior of organs (which is only possible in the living body), whether in the blood- or lymph-vessels or in the tissue itself, or when the unmistakable evidences of their influence upon the invaded tissues are present (as, for instance, necrosis of the cells of a certain region, accumulation of round cells in the neighborhood, penetration of foreign organisms into the cell body, etc.), such micro-organisms must be regarded as pathogenic." The changes described by me, as found in the Haversian canals and marrow of the bones, furnish, I think, a goodly part of the conditions required for the fulfilment of Koch's postulate; while the discovery of micro-organisms in the medullary substance of the bone proves positively that these changes could only have been produced by the action of a pathogenic microbe.

On the Genesis of the Changes Observed in the Endolymphatic Space.

It would be very difficult to establish a connection between the genesis of such neoplasms and the influence of pathogenic micro-organisms, if our observations were limited to the later stages of their growth. Fortunately my specimens enabled me to observe them from the very beginning, thus rendering their explanation comparatively sim-

of Schwann, total destruction of the nerve fibres, and formation of molecular fat-cells. *Virchow's Archiv*, Bd. lxxxv., S. 181.) Mendel (Verhandlungen der Berliner medicin. Gesellschaft, 1884) reports a case of diphtheria in an 8-year-old boy, which resulted fatally in 6 weeks, owing to paralysis of respiration. During life, paralysis of the ocular muscles, general paresis, and absence of knee reflexes. Autopsy—capillary hemorrhages in the pons and medulla, interstitial and parenchymatous neuritis of motor oculi, abducens, and vagus nerves.

¹ Zur Untersuchung von pathog. Mikroorganismen, von Reg. Rath. Robert Koch, *Mittheilungen aus dem Kaiserlichen Gesundheitsamt*, Bd. i., S. 2.

ple. The endolymphatic space has no blood-vessels. The lymph corpuscles are the only morphological elements of the endolymph, which, according to Dähnhardt's¹ experiments on fishes, is a perfectly limpid, slightly viscid fluid, which, after standing for some time, separates into small gelatinous lumps and a thin watery fluid. It contains 1.5 per cent. of solid ingredients, a small quantity of mucin, chloride of sodium, phosphoric and sulphuric acids, and traces of lime. No albumen is found.

Now what happens when micro-organisms penetrate into a cavity containing such a fluid? First, we have a purely mechanical process; a part of the fluid coagulates. This is no mere hypothesis, but a solidly established fact. Then a number of lymph cells, grouped together and enclosed in the meshes of a coagulated gelatinous fibrillar covering (let us say with Dähnhardt, composed of mucin), lodge upon the epithelium of the membranous semicircular canal, in one or more places (sometimes also in the middle of the canal, often choosing a spot free from papillæ, sometimes upon the surface of one, or frequently in both places simultaneously).

The inner ends of the coagulated threads adhere to the epithelial layer, subsequently coalesce with it, two or three of the epithelial cells become fusiform in shape, and the pedicle of the endolymphatic mass is thus formed. It is now quite evident that a single conflux of lymph cells having once obtained, and coagulation having taken place, similar accumulations continue to form until the whole endolymphatic space is filled up. This is quite obvious upon examination of the most superficial, that is, the youngest layers of the endolymphatic cell-mass, as seen, for instance, in Fig. 5, representing a section through the upper part of the mass found in the endolymphatic space of labyrinth No. 1. The different layers may be counted, one upon the other, each representing a special convolution composed of coagu-

¹ Endolymph and perilymph—Arbeiten aus dem Kieler physiologischen Institut, 1869. According to this author (*l. c.*) the perilymph is a clear fluid, which exposed to the air forms a jelly-like mass, containing 2.1–2.2 per cent. of solid ingredients, mucin somewhat more than the endolymph, albumen, salt, lime, and sulphuric and phosphoric acids.

lated threads enclosing lymph cells in their meshes. In the next place it is highly probable that the further changes, proliferation and division of the nuclei, are caused by the additional entrance and formative irritation of micro-organisms. At all events, it is certain that the appearances further described and illustrated by Figs. 7, 8, 9, and 10 have proceeded from the giant-cell territories, and I have no hesitation in declaring the conditions described in Figs. 4, 5, 7, 8, 9, and 10 to be an exact example (paradigm) of cellular pathology. In the inferior vertical canal of petrous bone No. 5, the blood-vessels, even those of arterial structure, have developed from the poly-nucleated cells. Discussion of this point, however, does not come within the scope of this paper, and I hence content myself with its mere mention.

Changes in the Perilymphatic Space.

These are somewhat more complicated.

1. Exactly the same process takes place in the perilymph as in the endolymph. My specimens show this best in its incipency, at the points where the membranous canal is connected with its bony counterpart. The events described, however, may take place at any other portion of the perilymphatic space (as is shown at *vk*, figs. 2 and 8) of the canal or ampullæ; hence the greatly varying conditions and the appearance of circumscribed cell territories in all stages of metamorphosis.

2. The endothelial cells of the periosteum and ligamenta labyrinthi in their turn undergo a change, but in an opposite direction to the process just mentioned.

Either:

- a. They are stimulated simultaneously with the cellular infiltration of the ligaments. This process leads to hyperplasia; the hyperplastic ligaments grow into the bony wall of the canal, and produce defects in its substance, thus destroying its elliptical form and rendering its configuration irregular and angular (Figs. 9 and 10). Exceptionally the hyperplastic periosteum grows into the cellular mass occupying the endolymphatic space, thus hastening its premature ossification. Or:

b. The endothelial cells of the ligamenta labyrinthi mortify, perish, and the ligaments appear as thin, structureless, atrophied threads, broken down, or perhaps are wanting entirely.

3. Finally, we have necrosis of the bony semicircular canal (see Figs. 2, 7, and 9). This is not the result of suppurative inflammation, but is a primary process brought about by global stasis and thrombosis (see Figs. 4 and 5 at *g*) of the small periosteal vessels, with ultimate destruction of the vessel itself.¹ When these theories are offered in explanation of the different conditions found in the perilymphatic space, the close proximity of neoplasm and necrosis, as shown in Figs. 2 and 9, is no longer paradoxical. It is seen that the "battle of the cells with the bacteria," when confined to comparatively small territories, may terminate in an exactly opposite manner. This may also be applied to the changes in the aquæductus vestibuli and to periosteum of the pyramid growing down into the interior of the bone.

How do the Micro-Organisms in Diphtheria Succeed in Reaching the Labyrinth and Pyramid of the Petrous Bone?

This is quite simple as far as the Haversian canals, medullary spaces, and perilymphatic space are concerned. They pass into the circulation through the lymph vessels and the thoracic duct. This has been verified by Heubner and Bahrdt² in a case of scarlatinal diphtheria with suppuration of the joint, in which chains of cocci were found in the pus, the cocci passing into the jugular vein through a sinus leading out of the diphtheritic tonsil. Microbes could also pass into the perilymphatic space of the cochlea (scala vestibuli) from the subarachnoidal space, through the ductus perilymphaticus of the aquæductus cochleæ. But how is it with the endolymphatic space, which has no blood-vessels? The investigations of Schwalbe, Key, and Retzius give us a partial explanation of this, these observations

¹ This has been described by Steinbrügge as seen in cerebro-spinal meningitis, and explained by Cohnheim (see his "Allgemeine Pathologie," pp. 271 and 272) as resulting from the direct action of the virus upon the small periosteal vessels.

² *Berliner klin. Wochenschrift*, 1884, No. 44.

having, as is well known, demonstrated several communications with the subdural space, as well as with the deep lymph vessels and glands of the neck. Schwalbe was the first to discover this by injection of the subdural space of the brain of the rabbit, and subsequent confirmation was given by Key and Retzius in experiments on the dog and rabbit. In the human subject the injected fluid chooses preferably the path around the arachnoidal villi into the veins. The proof of a communication of the subdural space with true lymph vessels shows it to be a true lymph space (Schwalbe "Neurologie," S. 785).

Moreover, subdural injection (Schwalbe, *l. c.*) reaches the corresponding spaces of the nerve roots, the fluid passing thence into the lymph channels of the peripheral nerves. (Key and Retzius). The subdural chinks of the optic and acoustic nerves are also easily injected, as well as the lymph vessels of the nasal mucous membrane, as first observed by Schwalbe and verified by Key and Retzius. The anatomical data point out a second way of entrance for the pathogenic microbe into the labyrinth, namely, from the subdural space along the subdural chinks of the auditory nerve. A third path is indicated in pharyngeal diphtheria, which so often coexists with the nasal affection, by way of the mucous membrane of the nose, into the subdural space.¹

Aided by anatomical experimental facts, we have now shown conclusively that the pathogenic micro-organisms may reach the subdural cavity. But how do they pass from here into the endolymphatic space? There is, to be sure, a communication between the ductus endolymphaticus and the vestibular sacs, but the former ends between two leaves of the dura as a "cul de sac." The microbes might possibly pass from the dura along the fibro-periosteal connective tissue with which it connects, thus reaching the aquæductus vestibuli. "This fibro-periosteal tissue presents a number of fine fissures (Rüdinger) which might possibly constitute channels." (Schwalbe, "Sinnesorgane," S. 401). This theory

¹Nasseloff: *Virchow's Archiv*, vol. 1., part 4, p. 550, in a case of a 1½-year-old diphtheritic child, found the nutritive canals of the submucosa and mucosa filled with bacteria; these were also found in the notches of the Haversian canals of the rough and disintegrated vomer.

is supported by the above-mentioned changes in the periosteum of the superficies of the pyramid of the petrous bone, which is described as dipping down into the interior of the bone, partially proliferated, to become again decomposed upon reaching the deeper regions (see Fig. 11).

Clinical Significance of the Conditions Found in the Labyrinth.

Almost every physician has had the opportunity of observing severe aural symptoms following pharyngeal diphtheria, resulting in partial or complete loss of hearing, within a few hours or days, and accompanied by disturbances of equilibrium which persisted for a long time after convalescence. This rapid and often complete loss of hearing, which has been so enigmatical to all observers until now, finds its explanation in the pathological changes described by me in this article, viz., laceration of the twigs of the art. audit. int. and necrosis of the ramus cochleæ and vestibuli caused by the hemorrhage (often simultaneously); likewise hemorrhage into the first turn of the cochlea on the one hand, with extravasation into the periosteum of the vestibule, maculæ, and cristæ of the vestibular apparatus on the other hand. This morbid process (which, I acknowledge willingly, could be diagnosed hypothetically before my demonstration of it) may cause complete loss of hearing in a few hours. As regards the disturbances of equilibrium, the changes described in the semicircular canals and ampullæ satisfactorily explain the cause of their existence. Upon this point I maintain the same position taken by me in my paper of 1881,¹ namely, that the centre of equilibrium is located in the cerebellum, and that this centre is connected with the nerve endings in the cristæ of the ampullæ, and perhaps with those of the saccule, so that disease or irritation of the end-apparatus itself, or of that of the neighboring organs, might produce the same symptoms as a morbid condition or irritation of the central organ. The experiments of Lichtheim are very interesting, and have an important bearing on the question as to whether irritation of the ampullar nerve endings may cause disturbances of equi-

¹ "Ueber Meningitis cerebrospinalis epidemica u. s. w.," Heidelberg, 1881.

librium. Lichtheim¹ thinks it likely that micro-organisms penetrate quite easily to the labyrinth and cause disturbances there. In this respect his experiments are especially worthy of notice, although no fission-fungi were met with. He injected a great number of the spores of the *aspergillus fumigatus* into the rabbit, and found that death was always preceded by disturbances of equilibrium; no traces of these fungi were, however, found in the brain, while a colony of them was discovered in the membranous labyrinth.

"The phenomena described are remarkably like those produced by injury of the labyrinth or intracranial section of the acoustic nerves." "No signs of inflammation or suppuration were found in the diseased labyrinth. I did not attempt a critical anatomical examination of the organ." Mycelia were, however, demonstrated in the membranous labyrinth. It is not stated whether the above-mentioned disturbances followed disease of one ear only (*l. c.*, S. 155.)

Treatment of Diphtheritic Disease of the Labyrinth.

As far as I know there is but one treatment of labyrinth affections due to ordinary pharyngeal diphtheria; in those following the scarlatinal form, however, there are several methods. The clinical symptoms in both forms are the same, viz.: a greater or lesser degree of deafness, frequently complete loss of hearing, more or less intense subjective noises, and after recovery from the constitutional disease, on leaving the sick-bed, vertigo, nausea (vomiting rarely), and soon the waddling gait noticed so often in children recovering from cerebro-spinal meningitis, which I have called the "duck walk." Whether the histological changes in the labyrinth are the same in both forms, is an open question; this is, however, highly improbable. It is hence interesting to pass in review the cases which have been successfully treated up to the present time. I was the first to use hypodermic injections of pilocarpin in scarlatinal diphtheria.² Five to eight drops were injected daily according to age, and comparatively good results obtained.

¹ "Ueber pathogene Mucorineen u. die durch sie erzeugten Mykosen des Kinnchens." Von L. Lichtheim. *Zeitschrift f. klin., Med.*, 1884, vol. vii., pp. 141-177.

² These ARCHIVES, vol. xiii., p. 232.

It was then used by Wolff¹ upon my recommendation, with favorable effect (in one instance complete recovery), and more recently by Schwartz² in a case following simple diphtheria. In view of the histological changes described by me as existing in the labyrinth, I have deemed a short consideration of the time, within which relief was obtained, not unworthy of our notice. In one case, defective hearing power already existed bilaterally, owing to otitis media purulenta, when the above-mentioned symptoms, indicating disease of the labyrinth, were noticed, and the hearing was almost completely lost. This happened about a week before pilocarpin was used. The result obtained was only fairly good. After a course of treatment the child, seven years old, recovered its hearing partially, and was capable of education, although the hearing never became normal. In Wolff's first case, the hearing was lost in sixty hours after the beginning of the ear affection, and, the relatives refusing to allow treatment with pilocarpin, deaf-mutism resulted. Vertigo lasted two months. In Wolff's second case, pilocarpin was administered after complete deafness had existed for a week, and a perfect result was obtained, capacity for hearing high notes being first re-established. The third case, a panotitis, I saw in consultation with Dr. Wolff, the eighth week of the disease, but, owing to the extreme weakness of the patient, treatment with pilocarpin was deferred until the tenth week, at which time it was undertaken by myself. At first favorable results were gotten, but six months after a new suppurative middle-ear process began, which was followed by complete loss of hearing. In Schwartz's case of a fourteen-year-old boy, simple diphtheria, lasting a week and not particularly violent, the hearing was remarkably bad on getting up, with marked vertigo and staggering gait and nausea; had vomited once. These symptoms were all still present three weeks after. When received at the hospital the hearing was not wholly extinct. Watch—left, 0; right, on contact. Whispered voice—right,

¹ These ARCHIVES, vol. xiv., pp. 137 and 149.

² Bericht ueber die Thätigkeit der R. Universitäts-Ohrenklinik zu Halle im Jahre, 1885. Von Dr. T. Kretschmann. *Arch. f. O.*, page 236: Fall von Labyrinth Affection nach Diphtheritis.

40; left, 10 *cm.* Tuning-fork—left, 0; right, only the notes of the four-marked octave. Three weeks' treatment with bleeding, quinine, and injections of pilocarpin. The vertigo disappeared in two weeks, but the gait was still unsteady. In the third week, "ordinary conversation is understood without great difficulty." It is thus seen that when the power of hearing is not entirely lost, permanent benefit may be obtained by the use of pilocarpin injections, even if commenced three weeks after the primary appearance of the aural symptoms. The treatment, nevertheless, should be inaugurated as early as possible, unless there are special contradictions. It favors absorption of the hemorrhagic exudation, otherwise leading to rapid decomposition of the tissues, and the changes described in the endo- and perilymphatic spaces, which at first consist only of lymphatic elements. It seems to me that it is even beneficial in the later stages, after decomposition of the already organized mass in the endolymphatic space has taken place (see Figs. 8 and 9). Where changes of the ramus cochlea, as shown in Fig. 3, are present, treatment is unavailing—the function of the cochlea is lost forever. On the other hand, however, it decidedly favors the absorption of pigment when the conditions presenting in the R. vestibuli, cristæ, etc., are as seen in Fig. 1. After absorption of the pigment, there is no predicting what the future behavior of the nerve will be, even with such defects, provided its structure and endings at cristæ and maculæ be normal. The attitude of the family physician in such cases is fraught with responsibility, for the ultimate destiny of the patient depends upon his action. If he carefully observes the condition of the organs of hearing in those of his patients who are stricken with diphtheria, he will often be able to administer pilocarpin before its use is contra-indicated by the depression due to the constitutional disease, and thus materially influence the chances of recovery.¹ For the sake of completeness, I will mention in closing that subcutaneous injections of pilocarpin are also

¹ The condition of the organs of hearing should be critically observed after the fifth day, for it is at this period that necrosis of the tonsillar tissue shows itself.

efficacious in other forms of labyrinth hemorrhage. The two cases lately reported by T. Barr¹ are presumably included in this category. One of the cases in question was of undoubted syphilitic origin. Politzer, as is well known, was the first to recommend pilocarpin in such cases, while the other was of the so-called apoplectiform variety, and probably caused by a hemorrhage.

On the Temperature in Diphtheritic Disease of the Ear.

It is still a mooted question as to how bacterial invasion of certain organs, and, further, proliferation of the micro-organisms in these organs, causes elevation of temperature. Baumgarten² does not believe this is brought about by the ptomaines, but thinks the pathogenic influence referable to the presence of certain abnormal, soluble substances, which paralyze the activity of the centre of heat. The above hypothesis is supported by the fact that there certainly exist products of bacterial decomposition, which give rise to fever, without the interposition of the bacteria themselves. This latter circumstance would also seem to prove that these soluble products fulfil another condition necessary to febrile disturbance, namely, increased oxidation. This leads me to doubt the supposition that bacteria ever contribute to the abnormal production of heat, except by leading to changes in their nutritive media, or by producing substances from themselves, which furnish the principal conditions of fever, viz., increased generation of heat and disturbance of the influences which regulate its production. This doubt is further supported by the absence of fever in certain diseases of acknowledged bacterial origin, as lepra, isolated cases of tuberculosis in man, and tuberculosis caused by inoculation of the rabbit. Trichinosis, although a real parasitic affection and not of bacterial origin, presents all the phenomena of an infectious disease, often accompanied by very high temperature and other severe constitutional

¹ Observations of two cases of sudden and extreme loss of hearing, on both sides, owing to disease of the nervous structures of the ear; materially improved after the hypodermic use of pilocarpin.—*Brit. Med. Journ.*, June 13, 1885.

² "Lehrbuch der pathologischen Mykologie," 1st vol., p. 109. Braunschweig, 1886.

symptoms. This, I think, favors the conclusion that the reproduction of certain organisms within the human body offers a rational explanation of the presence of the symptoms under discussion without the intervention of a special virus. May it not, however, also depend (whether fever be present or not) upon the manner of invasion, whether scanty or copious, languid¹ or energetic? Long experience has convinced me that energetic invasion is the rule in diphtheritic otitis, the temperature rising to 40° C. at the onset, with rapid extension of the morbid process. The opposite to this condition I deem to be a rare exception.

We have up to the present time had no records of the temperature of uncomplicated diphtheritic ear affections. I therefore append two such cases which fortunately have come under my observation. It is seen from these that the diphtheritic process is accompanied by quite an irregular temperature curve, which resembles that of no other disease; and also that it persists three times as long as the fever of the ordinary suppurative middle-ear inflammation.

In the genuine uncomplicated aural catarrh, the temperature falls about the ninth or tenth day, in both unilateral and bilateral forms; while in the diphtheritic inflammation it lasts three weeks or more. It is quite probable that the duration of the febrile process depends upon the extent of invasion by micro-organisms. In any case, their capacity for the generation of heat is not exhausted before the end of the second week.

I submit four fever charts, the first and second for the sake of comparison.

Chart 1—History.—Otitis media acuta purulenta dextra.

Girl sixteen years old; furious pain for the last two days, radiating towards the right side of head. Twenty-four hours later a discharge appeared. Cathartics and leeches without effect. I saw the patient two days after the onset in consultation with the attending physician.

¹ This may have been the case in the lepra cited by Baumgarten, and in many cases of chronic tuberculosis in man; also hereditary taint is not excluded. In several cases of tuberculosis in the rabbit, I noticed the disease progressed rapidly only at the point of inoculation on the bulbus oculi, while in the internal organs the ravages were less marked and extension of the disease very slight.

Status præsens: The inner end of the bony external ear canal is much swollen, so that only the pulsating centre of the perforated *Mt* is visible; profuse discharge; initial evening temperature, 104° ; fever went down on tenth day. Treatment: ice; subcutaneous injections of morphine; boracic acid locally; cicatrization of the perforated *Mt* in three weeks.

Chart 2—History.—Otitis media acuta purulenta duplex.

Boy, aged nine years; attending physician ordered cold water, May 5th, to be snuffed up the nose for the relief of intense coryza. May 6th, intense pain in left ear; temperature 103.6° . Condition May 7th: adenoid vegetations; *Mt* perforated; profuse discharge; remission of pain. May 11th: pain right; pus in the tympanum, but no injection or bulging of the *Mt*. These appearances persisted until May 14th, when paracentesis. Cicatrization, *r.*, May 20th; *l.*, May 31st.

Chart 3.—Otitis media diphtherica duplex. In consultation with Dr. Stehberger, of Mannheim.

Girl, eight years old; has not been to school since January 28, 1882. January 31st, diphtheritic croup without fever. February 5th, scarlatina eruption. From the 11th to the 19th of February, nephritis and rheumatic pains in the joints; recovery from both of these February 19th. In the meantime, however, February 17th, appearance of a fresh nasal and pharyngeal diphtheria. February 21st, the membrane in the throat has disappeared. February 23d, right middle ear catarrh with perforation: adenoid vegetations and bilateral swelling of cervical glands. February 27th, perforation of *Mt*, left. March 5th, renewed tympanic pains in right ear; March 7th, in left ear. From this time on the bilateral discharge, hitherto *very* copious, decreased gradually; cicatrization, *r.*, was deferred for months after; left, the perforation still persisted a year ago.

History of Chart 4.—Otitis media diphtherica dextra.

I made the first examination at the request of Professor Erb, April 30, 1884. Ringing in the ears and deep seated pain has existed since yesterday; right, radiating headache, and some hardness of hearing; posterior half of *Mt* red, bulging, and about to perforate. On the following day, diphtheritic membrane was noticed on the bony circumference of the perforated tympanic membrane; profuse discharge; remission of the subjective symp-

toms. May 2d, the patient is completely free from pain, and remains so until May 20th, when suddenly, about noon, apparent cessation of the discharge, with violent headache, vomiting, and rise of temperature from the normal to 100° . Upon examination the hole in the *Mt* is found closed by a diphtheritic plug. Removal of this was followed by disappearance of the above symptoms; complete recovery. Boracic acid was the only remedy used.

In this case the fever lasted three weeks. During this whole period the little patient was examined several times daily by Professor Erb and his assistant, Dr. Hoffmann; but beyond the otitis, no other abnormalities were observed.

For this reason I doubt very much that the diphtheritic process of the ear was the sole cause of the temperature. In the preceding case (No. 3) there was no doubt that this was the case. The importance of this point is very evident, inasmuch as it enables the physician to explain the presence of fever by the diphtheritic process alone, when he finds the internal organs intact. I am indebted to Professor Erb and his assistant, Dr. Hoffmann, for their kindness in furnishing the following extract of the history of Case 4, with the record of the temperature: H. V., eight years old; received at the Heidelberg Medical Clinic, April 10, 1874, discharged June 22, 1885. Clinical diagnosis: Diphtheria with widely different complications.

Previous History: Family history good; never seriously ill before; complained three days ago, in the evening, of headache and loss of appetite; has lost his usual sprightliness and vivacity. April 8th, the consulting physician noticed the presence of fever; the repeated complaints of the patient led to the examination of the throat, and discovery there of a whitish exudation. April 8th, evening temperature 104° . Yesterday a thick grayish-white membrane formed rapidly in the throat, accompanied by correspondingly severe dysphagia, in spite of the remedies used. It was now decided to remove the child to the hospital.

Status præsens: April 10, 1885: The patient is a very intelligent, obedient, powerful boy; no somnolence or signs of general weakness. His conversation is almost unintelligible, and is characterized by the unpleasant fulness of tone present in great hypertrophy of the

tonsils ; also marked nasal intonation ; considerable diffuse, hard swelling of the submaxillary glands on both sides, rendering opening of the mouth difficult. The passage in the throat is hardly the size of a large goose quill. The constriction is caused by an enormously thick grayish-white exudation which is firmly adherent to the uvula, soft palate, both tonsils, and, as far as can be seen, the posterior and lateral walls of the pharynx ; strong fetid odor from ear.

There is a continual discharge from the nose, of a thin, dirty, light-yellow fluid, which excoriates the upper lip. The mucous membranes of both nasal passages are likewise covered with a thin diphtheritic exudation. Lungs and liver normal. Spleen slightly enlarged. Powerful cardiac action and good heart sounds. Pulse 96-108 and relatively good, considering the extensive ravages in the throat. Temperature 99.7° , rising to 101.3° in the evening. Urine scanty, somewhat turbid ; no blood, and considerable albumen. Treatment : Chlorate of potash internally and gargled. Pharynx painted with a diluted solution of hydrarg. bichlor. Inhalations of aq. calcis.

The local diphtheritic process persists from the 10th to the 20th under frequently threatening circumstances. Paresis of the soft palate still persists, with temperature 99.3° to 100.6° .

April 20th to 23d.—General health good.

April 23d to 28th.—Repeated palpitation of the heart. First sound is dicrotic, and a systolic murmur is often heard over the left ventricle. Middle position of heart. Pulse becomes more frequent, 120-128, and cannot be brought below 108 by digitalis and salicylate of soda. Temp. ranges as high as 103.5° . Here a slight change for the better occurred, but the temperature rose again April 29th, accompanied by chilliness, headache, vomiting, and slight stupor. From April 29th to May 1st the temperature ranged from 101.3° to 103.5° , with loss of hearing and pain in the left ear. Tinnitus. The diagnosis of otitis media was confirmed by Prof. Moos.

May 1st.—Perforation of the tympanic membrane and disappearance of cerebral symptoms. Profuse thin discharge from the ear. Boracic acid locally. The otorrhœa persisted until May 31st, the patient remaining feverish, but in a fairly good condition. From this time on the fever disappeared, but cardiac symptoms still persisted. Urine contains no more albumen. Serious nervous phenomena now intervened, almost resulting fatally. These were as follows :

1. Paresis of accommodation and paralysis of the ocular muscles.
2. Paralysis of the soft palate and muscles of deglutition.
3. Marked paresis of both legs and arms (less marked), with distinct ataxia; absence of tendon reflexes.
4. Paresis of the right half of the diaphragm with very menacing attacks of dyspnoea; rapid relief followed galvanization.

Discharged June 10th. Sixth months later the boy was quite well, the only remaining evidence of his illness being a slight roughness of the first sound. Heart in middle position.

Final Deductions.

We have presented in this article a series of changes in the labyrinth which are undoubtedly traceable, at least in their incipency, to the influence of a pathogenic micro-organism. We have then endeavored to render a certain group of functional disturbances consonant with the existing anatomical conditions: on the one hand, the loss of hearing and disturbances of equilibrium, with the marked changes in the acoustic nerve; on the other hand, with the organic disturbances in the semicircular canals, ampullæ, and their cristæ. There are, however, a number of infectious diseases marked by the same complex of symptoms, but in which the pharynx is unaffected. The infection in such cases must, it seems to me, be due to the presence of the specific bacteria of the disease and not to bacteria of accidental importance as in diphtheria. I am, however, convinced that there would be very little difference as regards the anatomical effect in either case as far as the consequences of the coagulation of the endo- and peri-lymph in the semicircular canals are concerned. In any case a field for study here presents itself which would seem to offer a rich harvest to those interested in the pathological changes of the labyrinth. An instance of this is seen in the recent rapid accumulation of literature on loss of hearing and disturbances of equilibrium following mumps. Lemoine and Lannois were, as is well known, the first to show that disturbances of hearing may be the initial symptom of mumps as a consequence of the infectious nature of the disease.

A. Ollivier claims to have found rodlike bacilli in the saliva, blood, and urine, of individuals affected with epidemic parotitis. These he declares to be the specific morbid agent of the disease, and explains the well-known complications in the mammary glands and testicles, by their presence in these organs.

Explanation of the Plates.

FIG. 1. Horizontal section through a part of the internal auditory meatus, the vestibule, the facial nerve and adjoining wall of the labyrinth—magnified five times. Pyramid of petrous bone No. 2. *rc* = ramus cochleæ. *rv* = ramus vestibuli. *rs* = R sacculi. *nf* = facial nerve. *cf* = lower limb of can. semic. frontalis. *u* = utricle. *ah* = ampulla horizontalis with its crista = *cr*. *vp* = thickened periosteum of internal auditory meatus. *sp* = structureless perineurium of a completely destroyed nerve bundle. *ta* = débris of the lacerated art. audit. int.

Those of the nerve-fibres which remain intact in the internal meatus are surrounded by greater or lesser spaces, which were formerly filled with normal nerve tissue; a few nerve twigs pass across from the vestibular branch to the neighboring periosteum at the right. These, as well as the ramus vestibuli are colored orange. The circular red line bounding the space between *r* cochleæ and *r* vestibuli and the periosteum is composed of nerve tissue infiltrated with pigment.

The periosteum itself, with the exception of the thickened portion, shows, slight hemorrhagic, but for the most part pigmentary, infiltration.

This is also the case with the periosteum of the vestibule, utricle, the horizontal ampulla and its crista. The pigmentary infiltration of the bands which hold the ampulla in place is not shown in the drawing. The sheath of the facial nerve is colored orange, to represent the still existing pigment-infiltration.

FIG. 2. Transverse section of bony and membranous horizontal semicircular canals of labyrinth No. 3, magnified five times. *hh* = normal membranous semicircular canal.

P = perilymphatic space, partly filled by a cellular mass in the stage of beginning ossification (seen with a higher power), and bounded by the wall of the bony semicircular canal, which is scooped out in several places by necrosis. The periosteum is destroyed in spots and poorly supplied with blood-vessels. The

bony layer' in the immediate neighborhood (seen with higher power) shows no bone-cells, or only a few.

FIG. 3. Horizontal section through the inner third of the internal auditory meatus, the cochlear nerve, the modiolus, and bony wall of the cochlea—magnified five times. Labyrinth No. 3.

sta = a space seen before and behind (right and left in the plate) the trunk of the acoustic nerve at about the inner third of the internal auditory canal (the result of nerve degeneration, due to earlier hemorrhages), through each of which passes a tortuous bundle of nerve fibres, still intact, though showing hemorrhagic infiltration. Near the basis of the modiolus, other apertures obtain between the nerve bundles, which here radiate in a fanlike manner. Nearer to the periphery (*rbm*) the nerves become normal again. The ganglion cells in the canalis spiralis modioli (canal of Rosenthal *gsp*), are likewise normal.

FIG. 4. Section parallel to the long axis of the petrous bone, through the medial limb of the posterior semicircular canal. Hartnack $\frac{3}{4}$, tubus o, labyrinth No. 1. *k* = bony semicircular canal. *g* = vessels of the periosteum. *hh* = wall of the membranous semicircular canal—only the epithelial layer is distinct, and it is lacking at that point where the mass filling up the canal is connected with the membranous wall. *ll* = ligamenta labyrinthi. *P* = perilymphatic space. *E* = endolymphatic space, almost filled up by a mass consisting of coagulated lymph and poly-nucleated cells.

FIG. 5. The same section as in Fig. 4, through the apex of the mass located in the membranous canal. Power and lettering the same as in Fig. 4. For the most part only sketched in.

FIG. 6 represents that part of Fig. 4 marked <—, seen with Hartnack $\frac{3}{4}$, tube No. o. The field shows coagulated lymph, fibrillar coagulations, and groups of lymph corpuscles, including large and oval mono- and poly-nucleated cells and giant cells.

FIG. 7. Transverse section of the frontal semicircular canal of labyrinth No. 3. Tubus null. The elliptical form of the semicircular canal has disappeared and the shape of the membranous and bony canals has become irregular. The first is caused by the uneven proliferation of the cellular mass filling the endolymphatic space and completely destroying it. The irregularity of the perilymphatic space is partly the result of the process in the endolymphatic space and partly due to changes of the ligamenta labyrinthi (*ll*) and periosteum of the bony semicircular canal. The

ligaments mentioned are still present but are shortened and irregular, with cellular structure, and the perilymphatic space *P* between them is quite empty. The border of the interposed periosteum is thickened in places, and at one place shows an indentation. At another point (*gw*) the ligamenta labyrinthi have fused with the thickened periosteum, the latter penetrating deeply into the bone. At the deepest point a blood-vessel is seen in transverse section (*g*). In the proliferous mass occupying the endolymphatic space are seen numerous encapsulated cell-territories, the largest of which is pear-shaped; others are oval and some round. These are filled with polynucleated and giant cells. Between these encapsulated cell colonies there are fusiform, round, and branching cells, with occasional streaks of connective tissue. The ground-substance is clear and homogeneous. All traces of the normal structure of the membranous wall have disappeared and several layers of fusiform cells, bounded by a narrow strip of connective tissue on the side towards the perilymphatic space, have taken its place, forming the capsule of the neoplasm. Blood-vessels are nowhere to be seen.

FIG. 8. Longitudinal section through the medial limb of the sagittal semicircular canal of labyrinth No. 3. Hartnack $\frac{3}{8}$. Tubus, No. o. *kh' u. kh* = bony semicircular canal. *hh* = membranous semicircular canal. *R* = perilymphatic space. The normal peri- and endolymphatic spaces are completely obliterated, owing to the coalescence of the proliferous mass situated in the endolymphatic space, with the periosteum of the bony semicircular canal. The wall of the membranous semicircular canal and its continuation (*hh*) are structureless and irregularly concavo-convex in contour, and in one place, owing to destruction of the neighboring cell-masses, is entirely wanting. The convexity is due in two places to purely mechanical influences, as at *fz*, where a collection of cells is undergoing fatty degeneration, and the cell-territory *vk*, which is the seat of ossification. Products of the fatty degeneration, partly granular cells and partly molecular detritus, are seen on the lower border of the endolymphatic mass, while to the right, a light spot represents the result of the breaking down and absorption of the decomposed cell-masses (due to crumbling of detritus during the preparation of the specimen). The remaining part of the mass is made up of vessels with a delicate network of connective tissue, containing round and oval cells in its meshes and stronger bands of connective tissue. To the

right of the drawing, at *rz*, is seen a collection of polynucleated cells. At *hh'* is shown a circumscribed cell-mass in which a few bone cells are observed, surrounded, to the right and above, by the products of retrogressive metamorphosis. The greater part of the changes represents evidently a later stage of the condition shown in Fig. 7.

FIG. 9. Transverse section of the lateral limb of the horizontal semicircular canal of petrous bone No. 3. Hartnack $\frac{3}{4}$. Tube drawn. The periosteum of the bony semicircular canal is partially decomposed and atrophied. The edge of this canal is indented, and in places eaten out by necrosis. The ligamenta labyrinthi are almost destroyed; one still remains preserved at *ll*, but infiltrated with cells. At *hl* a hyperplastic ligament is seen, which has insinuated itself into the partially ossified mass occupying the endolymphatic space, forming, in a measure, the periosteum of the adjoining ossified cell-territory. As a result of the decomposition and absorption of the decomposed masses, different-sized spaces obtain in several places, the largest of which, (shaped like a leg of mutton), at the left of the illustration, still shows the structureless cortex or limiting membrane of the former cellular conglomeration. *P* = peri-lymphatic space of irregular configuration.

FIG. 10. Transverse section of the still intact sagittal semicircular canal of petrous bone No. 5. Hartnack $\frac{3}{4}$, with tube drawn out. The form of the membranous as well as bony semicircular canal is very irregular, almost square. There is no trace of either endo- or peri-lymphatic spaces. The latter has been obliterated by a hyperplastic proliferation of the ligaments of the labyrinth and periosteum. The spaces at the right and in the middle of the drawing are the result of necrosis of the bone and its periosteum. The mass seen projecting into the space on the right, when seen by $\frac{3}{4}$ power, still shows a few bone corpuscles. In the middle space is seen the débris of the (primarily thickened) periosteum, the result of its secondary decomposition. The accumulation filling the former endo-lymphatic space looks greatly like a vascular tumor. In many instances the vessels have arterial structure (*a*). At different points in immediate vicinity to the blood-vessels, are seen polynucleated (giant) cells (*rz*). The origin of the vessels from these cells is in several places quite evident from the fact that the wall of the vessel is still seen surrounded by the regularly arranged nuclei of the primary cell (the

peripheral zone of the giant cell-territory). Between the vessels are seen round and oval cells lying in the light intercellular substance. In the region where peri-lymphatic space and periosteum formerly existed, are seen fusiform cells.

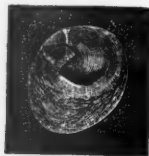
FIG. 11. A medullary space of the pyramid of petrous bone No. 3, in the neighborhood of a horizontal section of the medial limb of the sagittal semicircular canal. Hartnack $\frac{3}{4}$. Tube drawn out. In the centre of the plate and to the lower right, is seen an accumulation of narrow cells, which are still normal. The fat-cells of the medullary space are almost entirely absent. The light places denote decomposition and absorption of the medullary substance. Some of these places still show the reticulated connective tissue, with a few remaining marrow cells in its meshes. At *C*, a group of colloid pellets. At *hk*, one of the Haversian canals infiltrated with oval and round cells. This cellular infiltration also extends to the periphery of the neighboring medullary space and its reticulum of connective tissue.

FIG. 12. A group of streptococci from a medullary space of petrous bone No. 3. Hartnack $\frac{3}{12}$. Oil immersion 1:650. The major portion of the contents of the medullary space has decomposed and been absorbed.

FISTULÆ FISSURARUM BRANCHIALIUM, TO-
GETHER WITH PECULIAR MALFORMATION
OF THE MEMBRANÆ TYMPANI.

BY OLE BULL, CHRISTIANIA, NORWAY.

The following case may be of considerable morphological interest. Joseph Haga, Eidsvold, was sent to me by Dr. Malthé, of this town ; examined first time June 20, 1886. He has never had any acute disease, but been somewhat weak. His sisters state that his hearing has always been dull. He has had for several years, at intervals, a discharge from one or the other ear, and has also, for a long period, been troubled with running from the nose. No consanguinity of parents. The left auricle is somewhat shorter and more concave than the right, their lengths being respectively 49 *mm* and 52 *mm*. On both sides, at the beginning of the helix, a depression like that left by a small pinhead is seen (rudimental mark of fistula fissuræ branchialis primæ). On each side, in the skin over the sternocleidomastoid muscle, are seen small openings ; on the right side the opening is situated 60 *mm*, and on the left 65 *mm*, from the lower margin of the auricle. A small probe can on both sides be introduced through the opening to the length of 5 *mm*. There is a small viscid discharge from the openings. The drumheads are defective, the membranæ flaccidæ being absent. The part remaining is situated far below,



and occupies only the under half on the space visible by means of the otoscope. The folds extending from processus brevis mallei

form the anterior and upper boundaries of the drum; in the upper and posterior part the boundaries are not well defined. The handle of the malleus is much retracted (*vide* drawing). Aspiration by means of Siegle's instrument produces plainly visible movements of the membrane. The length of the upper wall of the auditory canal, measured from the outer aperture, is 30 mm; that of the lower, 37 mm. By inflation through the Eustachian tube by means of a catheter, the air is heard and felt in the ear of the physician, as in cases where the membrane is absent or very defective. No alteration of the membranes was seen by inspection immediately after the inflation. The respiration of the patient is very distinctly heard through the diagnostic tube. Frequently, in syringing the ear, the water is made to issue from the corresponding nostril. Attempts to introduce probes through the Eustachian tubes were not successful, as this manipulation caused pain to the patient when the probes were introduced as far as 6 mm beyond the beak of the catheter. By anterior rhinoscopy nothing abnormal could be seen. Retropharyngeal inspection had to be abandoned on account of the timidity of the patient. At the time of examination there was an accumulation of mucus on the right drum. The patient could hear a watch when pressed against the auricle, and was able to understand loud speaking at a distance of a couple feet. His speech was not perfect, but could easily be understood. I saw him a second time the 5th of August, 1887. There was then some mucus in the left meatus; the nose running. Otoscopical appearance was unaltered. The sisters of the patient told me that his pronunciation of some words during the last year had become less distinct.

There have been, as is well known, at different times different opinions about the origin of the meatus and the Eustachian tube. The first opinion was, that both were remains of the first branchial cleft. This has, so far as it concerns the external auditory canal, been proven not to be the fact. This canal is developed by growing of the masses surrounding the membrane. Consequently the latter is not originally a fenestral membrane growing into a preëxisting canal and dividing this into an interior and exterior part, viz., *cavitas tympani* and *meatus externus*, but becomes so by degrees, while the external meatus is developing, and the tympanic cavity becomes pneumatic. That the outer

layer of the membrane is a product of the epiblast, lying at first on a level with it, is concordantly settled. As to the Eustachian tube, the opinions of authors still differ. Some believe that the tube has nothing to do with the first branchial cleft, but is formed by an extension, either of the intestinal canal (Moldenhauer, Rauber) or of the cavity of the mouth (Urbantschitsch, Schenk). Other authors (Kölliker, Balfour, Albrecht) adopt the opinion of Reichert, viz., that the Eustachian tube is a derivative of the first branchial cleft. According to Albrecht, whose investigations have thrown a new light on the development of the ear,¹ the Eustachian tube is derived from a branchial cleft lying between what he calls the palatine arch and the mandibular arch, and not between the mandibular and hyoid. It is a promandibular tube analogous to the spiraculum of the selachoides, and is situated in front of the dorsal part of the mandibular arch or epimandibula. This is = malleus + incus + ossiculum lenticulare + stapes = columella of the sauropsida and amphibia. The hypomandibular part of the mandibular arch is a mandibula which articulates with the os quadratum = os zygomaticum and its process, with the cavitas glenoidalis lying between them. Consequently there exists a perfect homology of this part in man and the lower vertebrates. The cavitas tympani is by the ossicula auditus divided into a proepimandibular and a postepimandibular part. To the former belongs the Eustachian tube; the latter becomes pneumatic from the fist, and has nothing to do with the branchial cleft. The tympanic membrane is likewise divided into a pro- and a post-epimandibular (-malleolar) part, the proepimandibular part being the membrana flaccida Shrapnelli. The cutaneous opening of the canalis tubo-protympanicus is, according to Albrecht, to be sought in the drumhead, where it may sometimes be seen as the Rivian foramen. In the case above referred to, the marks at the beginning of the helices and the fistulæ on both sides of the neck indicate a retarded closure of

¹ Über den morphologischen Werth des Unterkiefergelenkes, der Gehörknöchelchen, und des mittleren und äusseren Ohres der Säugethiere. Troisième Congrès International d'Otologie. Bâle, 1885.

the branchial clefts. Whether or not the defective state of the drumheads and the free opening of the Eustachian tubes above these, are to be regarded as a consequence of a retarded closure of the first branchial cleft, must remain doubtful. If answered affirmatively, we would have to suppose that the promalleolar (proepimandibular) part of the drum membrane had not (on account of an exceptional breadth of the proepimandibular canal?) come into contact with the postmalleolar (postepimandibular) part. However, the marks of the *fistula auris congenita* here, as always,¹ being situated upwards and in front of the auditory canal, indicates that the cutaneous opening of the *canalis tubo-protympanicus* is not, as Albrecht supposes, to be sought in the drumhead. For the same reason the exactitude of the division of the drumhead into a pro- and postepimandibular part becomes doubtful.

¹ I have several times seen such marks, and in three cases (on one side only) canals. These have always been situated immediately in front of the helix, about 10 *mm* above the tragus.

CONTRIBUTIONS TO THE ANATOMY OF THE EAR.

BY DR. A. BARTH, BERLIN.

Translated by J. A. SPALDING, M. D., Portland, Me.

(*With one wood-cut.*)

HAVING devoted many years to the anatomy of the ear, and especially to the microscopic anatomy of the labyrinth, it is my intention to publish, in the future, occasional reports that shall attempt to explain various points in this province that are still dark or disputed. These shall show my present convictions and views attained independently of other observers. But before describing any anatomical preparations, I feel as if I ought to prefix a few remarks on the methods of treating them, and particularly in regard to the best methods of imbedding specimens, so that others who may be hereafter inclined to study this branch of anatomy may be spared a great deal of superfluous work. Yet in this respect I hope to be brief, because when hereafter explaining some single specimens, I may be compelled to interweave various remarks on this self-same topic.

Imbedding of the Ear.

When I began my investigations, Schiefferdecker advised me to employ celloidin, which he and Merckel had just tested for imbedding various other organs. And, indeed, at the very first attempt, I obtained some excellent preparations. Nevertheless, from time to time, I tested every one of the imbedding methods that were one after another highly recommended, only in the end to return to the cel-

loidin, which I have since employed exclusively, except in "teased" preparations, and a few others which I intend to mention in their proper places.

When the specimen has once been suitably treated and is ready for imbedding, it is first laid in diluted alcohol, and after two or three days in absolute alcohol, from whence it is either at once transferred into a solution of celloidin about as thick as commercial collodion, or previous to this step and perhaps more advantageously into a mixture of about equal parts of ether and absolute alcohol. After once reaching the celloidin the preparation remains for eight days in a wide-mouthed bottle, or if it is very large, fourteen days or even longer. The cork is then to be lifted a trifle so that the mass can thicken, and later on we add a fresh solution of celloidin of rather thicker, syrupy consistence sufficient to keep the preparation constantly covered. The drying process should be continued until the celloidin ceases to run, or is as stiff as thick jelly. We next pour upon it diluted alcohol of 60 to 70% strength. A couple of days later, the preparation is removed, and is then left, after the superfluous celloidin has been trimmed away, for three days in diluted alcohol, and finally fastened for cutting. It should be clamped as firmly as possible, especially when we wish to make a regular series of sections. After the preparation has been dried with a cloth or with blotting-paper, I have found it very advantageous to dip into ether the broader surface intended for fastening, and then for some time to press this evenly upon a bit of dry cork, on which a drop of thick celloidin has previously been laid. Pressure can be most practicably applied by fastening the preparation and the cork between the arms of a pair of anatomical forceps. Whilst still in this position, it is to be laid once more in diluted alcohol; after a few hours the forceps are removed, and in two or three days it has clung so firmly to the cork that it is ready for cutting, which should be done under diluted alcohol.

Imbedding in celloidin is, as we see, a slow process, for it is as much as six weeks before we can obtain sections of a large temporal bone. But the greater our patience, the

more successful an imbedment we obtain as our reward. There is no need to open the inner ear beforehand in cases of celloidin-imbedding, unless we deem it necessary for other reasons. The finer tissues seem to suffer less by this method than by any other. So far as tinting the specimens is concerned, we should remember that all substances which attack celloidin, such as gold chloride, silver nitrate, hyperosmic acid, etc., cannot be employed after the imbedding is complete. Nevertheless, with carmine, hæmatoxyline, the aniline tints, and picric acid, we can obtain just as successful tintings and double tintings of the various sections after the imbedding, as of preparations that have never been imbedded at all. If we intend to place the sections later in resin, we should remember not to leave them too long in the absolute alcohol, and not to clear them up with oil of pinks, because by either process the celloidin will be dissolved. The best substances for clearing up specimens are oil of Spanish hops, or cedar-wood oil.

I have occasionally tried other imbedding than celloidin, but only when preparations have been soft or uncalcified, or from early embryos, or where the temporal bone has not yet largely ossified. And here, paraffine is better; it gives thinner sections than celloidin, but they are crumbly and fold easily, and the tissues do not appear precisely normal, nor do we obtain such delicate images as the celloidin imbedding offers. The latter is therefore to be recommended even in these preparations, at least for the sake of comparison. Finally, I have made sections of some preparations without any imbedding at all.

Casts of the Inner Ear.

Whilst experimenting with various imbedding methods, I stumbled upon one for casting the cavities of the labyrinth, *with preservation of the soft parts*. And since it affords us an entirely new and clearer glance into the coarser structure of the inner ear than all the other troublesome and difficult methods hitherto proposed for thus preparing this organ, I will sketch it briefly.

The temporal bone, uncalcified and unopened, after being

hardened and tinted (osmic acid), is placed in diluted and then in absolute alcohol, and finally in chloroform, where it remains sufficiently long to become thoroughly impregnated—that is to say, for several days. We then melt paraffine at the lowest possible temperature (it should not feel disagreeably warm to the finger) and removing the preparation from the chloroform, we place it instantly into the paraffine. In this way the chloroform evaporates very slowly; then the paraffine must be kept in a molten state, at the lowest possible temperature, till no more vapor arises, which will be about six hours in the case of a human temporal bone. But according to my experience we can so regulate the flame, that something else can be going on at the same time, which need not however hinder us from keeping an eye on the casting. After letting the paraffine cool off rapidly, we cut out the preparation, but leave a small clump of paraffine at the meatus auditorius internus, or at the round or oval window for subsequently fastening the specimen. When this is to be done, we first remove the stapes and pierce an aperture in the membrana tympani secundaria before soaking the specimen. The rest of the paraffine should then be scraped away to the bone. The specimen is next to be laid in concentrated or nearly concentrated muriatic acid for eight to fourteen days, according to its size. Finally the preparation in which the cast of the inner ear is now almost entirely visible, must be carefully transferred into water, and here with a narrow nozzled syringe the remaining adherent tissues are to be washed thoroughly away.

In this way we obtain a cast of the entire inner ear, with the soft parts included, sometimes with and sometimes without preservation of the periosteum of the scala. In such a cast we see every thing that can be recognized in a cast of the osseous labyrinth, and additionally, though it is not perfectly transparent, the situation of the facial nerve in relation to the auditory nerve and inner ear, the entrance and distribution of the nerve filaments upon the ampullæ, the expansion of the cochlear nerve, and the course of the ductus cochlearis and membranous semicircular canals in

the bone. In the ears of children, up to the age of about ten years, we obtain the inner ear in moderately firm connection with the nerve stems, so that finally, for preservation, we can place the preparations neatly against casts of the inner meatus. In adults, the places where the nerves cross to the inner ear have become so narrow, owing to advanced ossification, that the preparation must here be treated very carefully in order not to break the points of support.

I have never yet succeeded in clearing up the preparation, *i. e.*, making it entirely transparent in the paraffine imbedding; on the contrary, it can be made somewhat firmer even for moderate warmth, if placed for a short time in water-glass, *i. e.*, liquor natri silicatis; then dried and even at a later date rubbed with the same at various soft spots. It seems to me too, as if, later on, it would be a good idea to see how the careful rubbing of the preparation with resin dissolved in chloroform would act.

Microscopic sections show us how far the soft parts can be protected from the corroding acids by the paraffine. Thus the supporting pillars of Corti's organ are almost always recognizable, as well as even the cells and nuclei, but these casts generally are not good for microscopic investigations. On the contrary, we can exhibit the membranous labyrinth by dissolving and removing the paraffine. This manipulation, solution in chloroform, gradual transference to ether, alcohol, and glycerine, must be performed very carefully, lest we disfigure, shrivel, dislocate, or rupture the structures of the vestibule, or still more easily the semi-circular canals. Nevertheless, we often obtain excellent preparations in this manner, and can subsequently tint them so that they may become more distinct in glycerine.

I have no doubt that we can obtain certain good results from this method of casting, though it may still be improved upon. It ought also to be of use in examining other cavities. Still, as I have not yet had, nor shall soon have, any opportunity to reduce it to scientific exactitude, I offer it to the profession for their benefit; perhaps some one will follow it up.

Steinbruegge's methods of celloidin casting¹ have never yet been tried for this purpose, but it really seems as if further investigations ought to be undertaken in this direction, since Merckel has spoken of it so highly.²

Crista Spiralis.

Voltolini's paper, "Ueber das Vas perforans dentes" (On the perforating vessel of the auditory teeth),³ led Boettcher⁴ to study carefully the vascularization of the anterior portion of the lamina spiralis, and to describe it in correspondence with the facts. Voltolini's incorrect assumptions do not, however, depend alone on an incorrect representation of the course of the vessels, but particularly upon an incorrect idea of the structure of the spiral ridge which these vessels pierce. The descriptions and drawings hitherto published cause so much misapprehension on this point that we must here briefly refer to it. But all that is contained in Retzius⁵ and Schwalbe⁶ shall remain untouched in so far as it is accurately clear.

I would also say that Boettcher's latest paper⁷ is not entirely free from errors, although there is no opposition between us on general grounds.

All previous reports on the lamina spiralis have been based upon "teased-out" preparations, in which the cones and ridges with their incisor-like shoots were viewed from above, and in radiating sections through the cochlea. But neither were sufficient to oversee clearly the structural relations, so that most of the drawings of radiating sections are not quite correct. This can best be proved by examining tangential sections from the lamina, or those made in various transverse directions. The examination will be favored by imbedding the preparation, because every little

¹ Corrosions-Anat. des Ohres, *C. f. M.*, Wiss., 1885, No. 31.

² 59te Versamml. Deutscher Naturforscher, p. 139.

³ *Virchow's Archiv*, Bands c. and civ. See also reference in these ARCHIVES, xvi., p. 44.

⁴ *Arch. für Ohr.*, Band xxvi., p. 1. See also reference in these ARCHIVES, xvi., 156.

⁵ "Gehoerorgan der Wirbelthiere," 1884, Band ii.

⁶ "Lehrbuch der Anatomie der Sinnesorgane," 1887.

⁷ *Arch. für Ohr.*, xxiv., p. 95.

particle, though separated from its connections, will nevertheless then remain in its proper position.

If the lamina spiralis in "teased-out" preparations or in horizontal sections is examined from above, we see Huschke's teeth extending over the sulcus spiralis internus like so many cones. Toward the modiolus they stretch out like ridges, which vary in length according to the species of animal and the age of the same species. In young persons (excluding embryos) they average longer, and are apparently less brittle than in the old. When they terminate, the cones begin, and extend as far outward as the insertion of Reissner's membrane. The "tooth" therefore terminates, so far as its upper surface is concerned, with the ridge extending inward, but how far down it extends we cannot tell from these preparations. Tangential sections are best chosen for this purpose, and here we see that in a series of successive sections, and directly behind the place where the nerve passes through the labium tympanicum, there arise on the upper surface, at nearly even intervals, rods which at first remind us externally of the foot of the supporting pillars when tangentially divided. They are broader at the base, and sligher above. Then follows an empty space, and still farther above that Huschke's teeth. If we push nearer and nearer to the modiolus, the transverse sections of the teeth are seen to send shortening processes downward, whilst those which climb up from below extend upward till both unite in a column-like rod, which is broad above, narrower in the middle, and then again broader at its base, which rests upon the crista. Consequently the opposite lateral surfaces are united below, whilst above they touch, and between them in their whole extent lies a fissure in which we generally find a cellular nucleus. Then farther still toward the modiolus, in the middle of the preparation, the apparent rods grow shorter and shorter, whilst the tissues of the crista increase in thickness, but to the sides on the contrary we see the same picture as has just been described, until we gradually fall again into the radiating sections. This description refers to sections perpendicular to the course of the toothed ridge; but if they are neither perpendicular nor

parallel to the ridge, but about midway between these two directions, then we see also the columnar-like cross-sections, but without the open spaces, containing nuclei, because these are now perspectively covered by the teeth-ridges, which run obliquely to the section, and extend downward. Under such circumstances it is not often that we see the columnar-like sections, partly because, owing to the thickness of the section, the variations in light and color are confused, and also partly because, from the obliquity of the sections, the columns become too broad, and so assume another form, and are, as it were, pushed in behind one another like the set-scenes of the stage. Nevertheless, in these very sections we obtain about such views as are usually reproduced in most of the text-books, but which do not afford us the slightest clue to the real structure of this portion of the crista. We are usually introduced to a perfect rectilinear upper edge, from which we see lines extending downward, with a concave curvature outward, and apparently dividing the tissues as far as the tip of the labium vestibulare into cones in which the nuclei lie partly between and partly bisected by the lines. Then there is no space between these cones. Now such a schematic representation of the parts as seen in the books, and even in Retzius, ought never to have been chosen.

It is plain from what has been said, that Huschke's teeth do not consist of cones, but that in their course inward and downward they form little plates, bounded above by the ridges which we see on surface-preparations, and outward by the almost semicircular indentation which gives that characteristic appearance to radiating sections of the outer surface of the lamina spiralis. Downward these pass over into a fibrous-tissue layer, the hyaloid membrane, which possesses just the same sort of an almost homogeneous but still distinctly fibrous arrangement as the plates and cones of the crista. This layer then passes outward in a thin stratum upon the membrana basilaris, increases in thickness as it crosses over to the lamina spiralis, is thickest in the region of the deepest indentation of the sulcus internus, and then decreases in thickness as it passes off in a curve up-

ward and inward to the insertion of Reissner's membrane. The fibrous structure (substantia propria) of the crista dissolves itself from beneath into this layer.

Schwalbe, also, speaks of "plates," but he means the ends of the teeth, which terminate outward and upward in a nine-pin-like top. But my "plates" would then correspond to those structures which Schwalbe calls the radiating ridge-like processes of the crista spiralis.

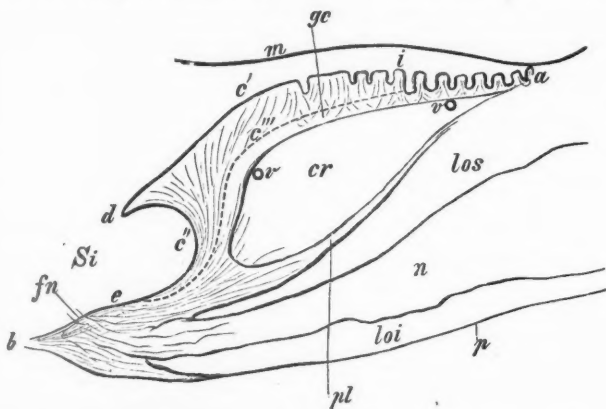
It is impossible from surface-preparations or from radial or tangential sections, to discover precisely how far the above-described plates extend inward before they give way to the cones. On the contrary, mention must be made of the impression produced by oblique sections striking the membrana basilaris near the insertion of the external supporting pillars, and then passing through the sulcus internus and the tooth-plate directly over the hyaloid of the crista, or, in other words, at about its deepest part.

The ridges in some species of animals, *e. g.*, in guinea-pigs, appear very long in surface-preparations, and in other animals, as man, very short. But the irregular cones do not lie precisely at the place where the ridges terminate, but at this locality we find shorter ridges and cones, which run in the same direction as the long ridges which have extended from the tooth. If now we compare the oblique sections, mentioned in the preceding paragraph, with surface-preparations, we find that in the former the ridges are much longer than in surface-preparations from the same individual and of the same age. I conclude from this, that the apparent division into shorter ridges, as seen in surface-preparations, and perhaps too the division into cones which lie in the same direction with the ridges, does not extend down to the base of the plate, but is really caused by a more or less superficial indentation of the latter.

The text-books have invariably asserted, and published approved sketches to the same effect, that the ridges which extend from the teeth to the modiolus, and consequently the tooth-plates themselves, run precisely in a radiating direction. Now in preparations which happened to have rods longer than the average, as well as in the oblique sections

above mentioned, it has really seemed to me as if these ridges ran in precisely the same direction as the membrana tectoria, that is from below and inward, obliquely to outward and upward, perhaps not quite so pronounced, but varying nevertheless a little from a precisely radiating direction. And this is important for questions to which I may later have to refer.

In regard to the form of the plates, we see from the above description that their diameter is less in the middle than above and below, so that between the various plates we find fissures in which lie the well known rows of cell nuclei. It would be purposeless and would carry us too far, were we to inquire more precisely into the form of the fur-



ther surroundings of the plates, for that depends, as well as the form of the lamina, on the species of the animal, and even in these on the age, and then still further whether we investigate more at the base or at the summit of the cochlea. So, on the whole, our results may be stated as follows:

Schematic representation of a radiating section through the lamina spiralis, lying precisely in the direction of the tooth-plate (ridge).

loi = lamina ossea inferior. *n* = nervus cochlearis. *los* = lamina ossea superior. *pl* = periosteal layer of the crista. *cr* = substantia propria of the crista. *v* = transverse section of vessel in same. *gc* = hyaloid of the crista. *ei* = (dotted line)—crossing of hyaloid tissue into the tooth-plate and cones. *e* = foot, and *i* = inner end of tooth-

plate. d = point of tooth (labium vestibulare). a = end of cone and insertion of m = Reissner's membrane. b = tip of the labium tympanicum. fn = foramina nervina. p = periosteum of the scala tympani. si = sulcus spiralis internus.

The upper curve (c') is well marked in the inferior convolution of the cochlea, but as the ascent is made into the upper convolutions, it grows less pronounced and even gives way to a downward curve (between c and d) which finally predominates in the superior convolutions. At the same time, the distance from the top of the tooth (d) to the insertion of Reissner's membrane increases from below upward. In young persons the form of this boundary line resembles more closely that in the inferior convolution, but in adults it bears greater resemblance to the other form. The limiting line outward (de) in the lower convolution lies almost perpendicularly over the lower tip of the plate (e). But as we ascend into the higher convolutions the tooth retreats farther backward, and the lower tip pushes itself forward as the labium tympanicum becomes elongated. The inferior boundary line shows in the inferior convolution an excessive curvature at c''' , whilst in the superior convolution it changes more and more into a straight line, so that a section through the substantia propria cristæ in radiating sections in the inferior convolution appears broader and shorter, whilst in the superior it is very narrow and long. Retzius does not seem to have described these conditions with any great amount of accuracy.

We can almost always see in good preparations a distinctly fan-shaped expansion of fibres extending upward from the lower tip (e). It also pushes out a bundle of fibres into the substantia propria cristæ, and especially to the periosteal layer. A delicate perpendicular row of fibres can be seen in those small columns which we obtain in tangential sections.

The upper surface is generally well defined in poorly preserved preparations, whilst in well preserved specimens it is usually more or less ill-defined, and I suspect that this appearance is due to the cellular deposit so carefully described by Retzius.

There are no vessels in the body of the teeth nor in the cones which lie farther on toward the modiolus, as Schwalbe and Boettcher emphasize. On the contrary, the vascular sections described by Voltolini (*v*) always lie directly beneath the hyaloid in the real substance of the crista.

It is easy to see from the above description of the parts, how we may make the simplest sort of mistakes in regard to the structure of the crista, unless we examine both surface-preparations, and sections running in every possible direction.

BI-LATERAL LABYRINTHINE AFFECTION DURING CEREBRO-SPINAL MENINGITIS.¹

BY H. STEINBRUEGGE, OF GIESSEN

Translated by J. A. SPALDING, Portland, Me.

The specimen, consisting of the temporal bones and the nasopharyngeal space, belonged to a boy of six, who entered the hospital December 23, 1885, complaining of vomiting and headache for three previous days; he had also been totally deaf for two days, and remained deaf till his death January 20, 1886. No convulsions, paralysis, or stiffness of the neck were complained of; temperature mostly normal, but occasionally irregularly increased. January 12th, he first complained of violent headache; 17th, vomiting and collapse; opisthotonos, headache, and death on the 20th.

Diagnosis: cerebro-spinal meningitis, despite the lack of typical symptoms. Therapeutics, calomel, and inunction with blue ointment; pilocarpine once hypodermatically. *Mt* normal.

The autopsy confirmed the diagnosis; leptomeningitis of the convexity and base of the brain; nothing to explain the total deafness, therefore a labyrinthine disease was suspected.

Microscopic Condition.

Slight congestion, and some mucus in the tympanic cavity.

Microscopic Examination of the Right Labyrinth.

Auditory nerve, in inner meatus surrounded with pus and infiltrated, particularly in the bottom of the meatus, where the nerve bundles are much loosened, and some entirely

¹ Read before the 59th meeting of the Naturforscher-Versammlung, Berlin.

isolated in the pus. Some bundles are green from chromic acid; others gray, and when highly magnified exhibiting swollen, broadened, and granulated fibres.

Facial nerve partially surrounded with pus, and loosened as far as the ganglion geniculi, where the splitting and isolation of nerve bundles is most marked. Nerve fibres occasionally swollen, but no degeneration or destruction visible. No pus on the nerve beyond the ganglion geniculi.

Nerve of vestibule and *ramus ad sacculum* also surrounded with pus.

Cochlea; modiolus full of pus cells, but the nerves can be followed quite out to the entrance into the ductus cochlearis. No change in the ganglion cells in Rosenthal's canal except in the group in the first convolution, in which the ganglia are fewer in number whilst the cells themselves are shrivelled and angular.

Ductus cochlearis; clumps of inspissated pus now above Corti's organ, anon close to ligamentum spirale, and finally in the angle which Reissner's membrane forms with the crista spiralis. Corti's membrane totally destroyed, but the organ still visible in its coarser details, the separate cellular tissues being reduced to a homogeneous mass. In other preparations, the destruction of Corti's organ has advanced still farther. Lamina spir. memb., lig. spir., and Reissner's membrane almost entirely preserved. Neoplastic connective-tissue strands extend from the latter membrane to the wall of the scala vestibuli; other neoplastic tissue with delicate vessels on the scala vestibuli.

Cochlea not congested.

Aquæductus cochleæ contains pus cells near the orifice into the cochlea; periosteum macerated.

Vestibule; perilymphatic space filled with neoplastic connective tissue, partly composed of fibrous network, partly of lamellar fenestrated tissue. Numerous broad blood-vessels, delicate of wall but full of blood corpuscles, penetrate the latter, and are here and there ruptured, with extravasations. At many spots we can still see the large ganglionic cells transforming themselves into fibres.

Utriculus well preserved in form, but rather dilated from

contraction of the surrounding connective tissue. A few sections still exhibit the contours of the nerve epithelium cells at the macula. Both upper ampullæ have resisted the destruction, but the bony space for the inferior ampulla is full of neoplastic connective tissue, whilst of the membranous ampullæ nothing can be seen. Hardly any trace of the sacculus; no cupulæ or otoliths in the utriculus, or in the two upper ampullæ.

Bony semicircular canals also filled with connective tissue, in which traces of the membranous canals were barely visible. The horizontal canal contained a blood extravasation probably arising from the neoplastic vessels. Periosteum of bony semicircular canals almost all gone, and the corresponding bone uneven and indented.

Left Labyrinth.

The destruction on this side was much more extensive than on the right, the bones especially showing greater ravages. The nerves in the inner meatus were equally imbedded in pus, and occasionally degenerated. In the modiolus itself, the degeneration of fibres and ganglion cells was very pronounced, whilst the cavities of the lam. spinalis ossea, in the inferior convolution, contained but a few swollen hyaline fibres with a multitude of granulated cells. The nearer the approach to the membrane of the round window in the lower convolution, the more the space was filled with neoplastic connective tissue, in which the lam. spin. ossea was with difficulty recognized. All the rest was destroyed. New connective tissue extended from the scala vestibuli to the vestibular space corresponding to the sacculus, and from the scala tympani into the aquæductus cochleæ, completely closing it. Following the sections upward through the various convolutions, we first saw fissures in the connective-tissue closure of the scala vestibuli; further up the neoplastic tissue in the scala tympani also ceased, *and a great amount of pus was found in both scalæ as far as the summit of the cochlea.*

Periosteum fibrous as on the right side; ligamentum spirale loosened from the bone; epithelium of membrana

basilaris lost, and in sections showing a thinned fibre; no traces of Corti's organs, but occasional glimpses of Reissner's and Corti's membrane were visible.

The bone adjoining the scala in the last convolution, and containing numerous cartilaginous deposits, showed incipient defects, which were still more marked in the recessus hemisphericus of the vestibule. So, too, in the other vestibular cavities in which the utriculus and superior ampullae had entirely disappeared, were visible alterations in the bone, which, denuded of periosteum, was full of indentations and covered with a thin layer of cells. The vestibule passed over into the space for the inferior ampulla, without any distinct demarcation. Bony semicircular canals partly empty, without any signs of membranous canals, and partly filled with detritus and bony lamellæ, as described in these ARCHIVES, xvi., 14., with this difference, that in this case there were no signs of thrombosis in the vessels.

The tympanic mucous membrane was slightly thickened in the window niches on both sides, and showed at some spots proliferation of the epithelial layer.

Remarks.

The pathological alterations by which this case varies from the one published in these ARCHIVES, vol. xvi., page 14, can be most simply explained by the longer duration of the attack; in the latter case the patient died within eight days, and the autopsy revealed excessive hyperæmia, rupture of the vessels, stasis, and thrombosis.¹ In some vessels separation and destruction of the epithelium were noticed, and necrosis of the periosteum, including superficial lamellæ of bone, but no tendency to the formation of new tissues. In this present case, however, after an attack of four weeks, the destruction had gone much farther: loss of left utriculus, left superior ampulla, both sacculi, degeneration of a portion of the auditory fibres, but at the same time neoplastic formation of connective tissue in a portion

¹ The blood extravasations in the present case originated simply from the neoplastic vessels of the fresh connective tissue, with thin walls. The normal labyrinthine vessels were not congested.

of the labyrinthine cavities. In this way we find much that corresponds to Habermann's case¹ in which the patient died in two weeks, only that in Habermann's case the bone destruction was much more extensive. Then, too, the cochlear convolutions were totally filled with granulation, with connective-tissue, and with neoplastic vessels, which extended into the aquæductus. Both cases agree in the presence of pus upon the auditory nerve as far as the ganglion geniculi and no farther, and additionally in the fact that the nerve fibres were most extensively separated at the floor of the inner meatus.

It is difficult in microscopic preparations to decide precisely the extent to which the auditory fibres have been destroyed, for exaggeration is so easy. Indeed, most of the fibres showed to the naked eye no signs of degeneration. The most positive sign of this condition was simply the absence of the chromic-acid tint, for the tokens of incipient destruction (swelling, granular opacification) were most easily discovered in the untinted portions. The destruction seems to have been very rapid.

I still persist in the belief expressed in the previous volume (page 14), that the contagium of cerebro-spinal meningitis (exclusive of the suppurative inflammation) may cause the labyrinthine tissues to mortify, since it excites the stasis and thrombosis in the minute periosteal vessels, and destruction of the vessels themselves, a process from which it is easy to explain the subsequent destruction of the membranous labyrinth. The rapid origin and the incurability of the deafness in so many cases, also argues in the same direction. The type of the diseases will of course vary with the intensity of the virus, just as in typhus and in cholera we see at one time severe cases predominate and at another those that are mild. But the further that we advance in our knowledge of infectious diseases, the more distinctly we see that the most terrible peculiarity of the contagium consists in a necrotic action upon the cells of the tissues or upon their vessels. I would here refer to the formation of cavities in tuberculosis of the lungs, and of

¹ *Zeitsch. f. Heilk.*, Band vii.

the bones, to intestinal ulcers in typhus and in dysentery, to gangrenous diphtheritis, and so far as our specialty is concerned, to the rapid destruction of the Mt in tuberculous patients, and to the extensive destructions witnessed in malignant scarlatina.

The contagium in Habermann's case, as well as in these two of mine, seems to have entered through the aquæduct, and to have acted directly upon the investing membrane of the perilymphatic spaces. On the other hand, it cannot be denied that the virus in cerebro-spinal meningitis has for the arachnoid tissue of the central organs of the nervous system, as well as for the sheaths of the cerebral and spinal nerves so far as they consist of processes of the arachnoid, an especial affinity, which results in the purulent inflammation of this tissue.¹

We must particularly notice that the boy's temperature was for the most part perfectly normal; only exceptionally and then irregularly increased. I believe that it is no rarity to find this condition of the temperature in those very enigmatical cases of sporadic cerebro-spinal meningitis which with but brief meningitic symptoms produce sudden deafness, and just as rapidly terminate in restoration to perfect health. Boucheron at the Basel Otological Congress mentioned two similar cases in children: in one, the entire attack passed off without fever; in the other, nothing higher than 37.8° C. (100.8° F.) was registered. It is on these two cases that Boucheron bases his theory of *otopîësis pseudo-méningitique*.

This condition of the temperature is, further, of *practical importance*. I lately saw a soldier who, so far as I could discover, had suddenly become so deaf, that only with the left ear could he just hear words shouted into a powerful ear-trumpet. Nevertheless, he was held at least six months in the hospital as a malingerer, because no one could discover any local ear or any constitutional disease. The only symptom had been a single attack of convulsions, which was however referred to simulation, *simply because the tem-*

¹ According to Hasse, the inmost enveloping membrane of the aquæduct consists of a continuation of the arachnoid.

perature directly afterward was normal. The case was probably one of rapid infection with cerebro-spinal meningitis and of labyrinthine disturbances. Let us not forget in this respect, that subjective complaints, *e. g.*, of headache, nausea, or vertigo, are not much thought of by military people, suspicious of malingerers, so long as the bodily temperature is not correspondingly increased. There is undoubtedly in many cases a rise in temperature, but it is generally of short duration, and often overlooked; then comes permanent recovery, or, after intervals free from fever, ensue relapses to which the patient may succumb. So it was in Habermann's case; the boy had high fever, then grew deaf, and stumbled, but his general condition rapidly improved. But, six weeks later, the meningitis relapsed and terminated fatally.

In all doubtful cases, therefore, take the temperature often, and take time enough to get a perfect registration upon the thermometer.

LABYRINTHINE DISEASE IN A CASE OF LEUKÆMIA.

BY DR. H. STEINBRUEGGE, GIESSEN.

Translated by JAMES A. SPALDING, Portland, Maine.

H. P. died January 8, 1887, at the age of 26. He was healthy up to the age of twenty, with exception of deafness in the left ear resulting from otitis media purulenta. At the age of 20, chancreoid, without secondary symptoms. Two years later he enlisted, but was discharged in six weeks on account of hoarseness, coughing, and dyspnœa. After that he was weak, easily wearied, *frequently attacked with vertigo*, headache, and palpitation of the heart. These conditions persisted in America whither he emigrated. A year later, frequent epistaxis and vomiting; urine often turbid. The patient returned to Germany, remained four weeks in the Cologne hospital on account of enlargement and pain in the abdomen; frequent epistaxis. He was admitted to our hospital in April, 1886.

Present condition: tall, enormously enlarged abdomen, liver, and spleen; inferior extremities œdematous. Ophthalmoscopic condition: left papilla œdematous, borders hazy, arteries pale, veins broad and tortuous, vessels in the periphery occasionally surrounded with small extravasations of blood; choroidal atrophic patches; right papilla more œdematous, vision good, though less than of old. 2,160,000 red blood corpuscles in a *cubic mm.*

June 5th. *Vertigo often perceived on going up stairs; excessive nocturnal sweating.*

July 30th. Boring pains in the right anterior wall of thorax (pleuritis).

September 5th. Great increase in white blood corpuscles (1, to 6 or 8 red).

October 7th. Temperature $39^{\circ}\text{C}.$; pain in the left shoulder, and over the spleen; pleuritic friction-sound left side.

October 28th. Great weakness, sleeplessness, constant pain in left side, frequent coughing, sharp, audible, and tangible grating over the spleen tumor.

November 3d. Loss of vision, and gray veil over left eye since yesterday; ophthalmoscope shows a large vitreous opacity, and a greatly enlarged blood-vessel with small extravasations beneath the papilla; vessels brighter than normal.

November 29th. Pain over sternum, coughing, nasal tampon on account of epistaxis.

December 8th. Excessive epistaxis, tampon; 1,470,000 red corpuscles in *one cubic mm.* Three white to four red corpuscles; the former very large. Increasing dyspnoea, dimness of vision in right eye also.

December 25th. About midnight *roaring in the head, then sudden deafness in the right ear.* Speaks with a loud voice and understands only by reading from the lips.

December 30th. Subjective noises, bells and singing.

January 8th. Violent pain in abdomen, dyspnoea, 40 respirations per minute, pulse small, temperature 37.8° . Death.

Clinical diagnosis: leukæmia, bronchitis, tumor of liver, perihepatitis, perisplenitis, ascites, retinitis leukæmica, hemorrhage into right labyrinth.

Post-Mortem Examination.

Suppurative bronchitis, emphysema of lungs, dilatation of heart, endocarditis, hemorrhage into left ventricle, enormous enlargement of the spleen and liver, parenchymatous nephritis on both sides.

Microscopic examination of the blood shows innumerable Charcot's crystals, most of which are elongated, needle-shaped octohedra, with a few twin-shaped. Most of the white corpuscles consist of large mononuclear cells, but some have an oblong nucleus, and are exquisitely eosinophile. A few small cells with large oval nucleus. No trace of nucleated red corpuscles.

Charcot's crystals enormously abundant in the bone medulla, but no nucleated red corpuscles.

Macroscopic Condition of the Right External and Middle Ear.

Meatus and *Mt* normal, floor of tympanum remarkably uneven, with numerous small recesses; a pseudo-membrane

extends from the floor to the round window and covers it almost entirely. Stapes united with promontory by connective tissue; tendon of the stapedius similarly connected with the niche of the oval window, and finally the tendon of the tensor tympani is broadened by a border of connective-tissue membrane.

Microscopic Condition of the Right Labyrinth.—Cochlea.

The two scalæ are largely filled with an extravasation of blood, which in the upper convolution is of a brownish-red color, and still shows the form of the blood cells very clearly, whilst in the inferior convolutions it has already fallen into granular degeneration. (The temporal bone had been left for a long time in alcohol.) Here and there in the granular mass, shining hyaline globules. The ductus cochlearis also shows extravasations, which chiefly occupy the region of the stria vascularis, and in some preparations rest firmly on Corti's organ, or conceal Corti's membrane. Reissner's membrane is intact. The same granular masses are visible in the aquæduct as in the inferior convolutions; cochlea veins remarkably broad, and seem to contain exclusively white blood-corpuscles.

Membrane of round window considerably thickened, and the thickened portion already shows ossification.

Further blood extravasations are visible in the neurilemma of the nerves of the internal meatus (also at the beginning of the facial nerve) and around the sacculi.

Vestibule.

The extravasation visible in the scala vestibuli could be followed into the lower part of the perilymphatic vestibular space; abundant extravasation in the sacculus itself, and in the utriculus a few cells. Nerve epithelium of the macula well preserved, as well as on the cristæ of the ampullæ. Cupula formations in some preparations, although in the ampullæ also, extravasated red and white blood-corpuscles were present.

Semicircular Canals.

The membranous semicircular canals are for the most part enclosed in neoplastic bone tissue, which in many sections

entirely fills the bony canals, although the contours of the original bony cavities are still distinctly visible. In other preparations, at less distance from the ampullæ, the neoplastic bony tissue does not totally fill the canal, and the fissures, whether large or small, are occupied by connective tissue, or osteoid tissue on its way to ossification. The connective tissue predominates near the ampullæ, whilst the ossification is found only at the junction of the bony and membranous canals. The connective tissue contains numerous fresh vessels.

The membranous semicircular canals appear small, but are well preserved even where they are entirely imbedded in the bone. Their inner epithelial investiture is distinctly visible, except that there were no papillæ; no extravasation within the membranous canals. The cavities of the spongy portion of the bone are for the most part largely filled with leucocytes.

Remarks.

Although it is a matter of regret that the ears were not examined or the hearing tested during life, yet there are a few data in the history of the disease which we can use in explaining the conditions found at the autopsy. The patient could hear with the right ear sufficiently well for ordinary conversation up to Christmas-day, but he had for years been very deaf on the left side owing to an old otorrhœa. But the hearing in the right side could not have been perfect up to the day mentioned, if we can judge from the numerous connective-tissue adhesions in the window niches of the tympanum. It is, however, impossible to tell when the middle-ear inflammation which left these connective-tissue traces behind occurred, whether in youth at the same time with the suppurative otitis media on the left side, or later when the leukæmia had already set in. It is certain, at all events, that the right-sided deafness came on suddenly fourteen days before the patient's death, and that it was probably caused by a blood extravasation which principally affected the cochlea.

The alterations in the semicircular canals are undoubtedly of much older origin. Were we to assume the formation of

perfect connective tissue at this region, within fourteen days, the ossification would contrarily attest that the inflammation which caused the neoplastic formation must have originated much earlier. It is also possible that the attacks of vertigo, which were mentioned comparatively early in the history of the disease were not due to anæmia, but to irritative conditions in the semicircular canals.

This case therefore once more resembles the two published by Politzer and Gradenigo, in so far as we saw here the products of *older inflammation*, as well as *fresh* extravasations of blood. It further resembles Politzer's case in the complication with bilateral middle-ear disease, and only differs from it in that in my case we found the ossification in the semicircular canals, and in Politzer's in the cochlea; and further still, in that in the latter case an abundant extravasation was discovered within the membranous semicircular canals, whilst in my case, the interior of the membranous canals appeared less affected, the largest amount of exuded blood corpuscles being found in the cochlea.

The abundant extravasations in the cochlea originated at a moderately late date, after lymphomata had already existed for a long time in other organs, and numerous smaller exudations had long been discovered in both eyes. This fact would incline us to believe with Gradenigo, that the labyrinthine vessels less easily permit an emigration of blood-cells than the vessels of the eye; or, in other words, that for this reason the percentage of ear diseases in leukæmia is, on the whole, small. But we must observe that Politzer's patient grew deaf a whole year before he died, whilst the sight did not decrease till afterward, and that Blau's patient exhibited symptoms of labyrinthine disease at the very beginning of the leukæmia; whilst finally we cannot deny that there may have been smaller extravasations in the periosteum of the semicircular canals in my case at a much earlier date than we suspect, and that they at this region, as already suggested, may have excited an inflammation which gradually became chronic. This, then, is the way in which Politzer's "Labyrinthine inflammation of a leukæmic nature" is to be regarded. Whether the

extravasated blood-cells are capable of further development into connective tissue has not as yet been decided, whilst, on the contrary, the periosteum of the labyrinth is undoubtedly subject to the formation of connective tissue after being exposed to inflammatory irritation.

At all events our material is as yet too small for us to draw conclusions in regard to the appearance and course of ear diseases in leukæmia. And the very complication of a previous attack of middle-ear disease renders any proper judgment of the case extraordinarily difficult. Thus, *e. g.*, we cannot decide whether the partial thickening and ossification of the membrane of the round window, due to the middle-ear inflammation, originated before or during the attack of leukæmia, or whether it may not have been caused by the latter. Besides all this we have to reflect upon the influence exercised by the same complication, *viz.*, syphilis, in both Politzer's case and my own. There were indeed no secondary symptoms in either patient, yet it is well known that syphilis may long lie latent in the body, only at a comparatively late date to reappear in the form of severe tertiary symptoms. It would be really difficult to make any reply to the assertion that the older periostitic inflammation of the labyrinthine cavities, which gave rise to the deposits of bony tissue, depended entirely upon constitutional syphilis, but further than this the fact of the existence of syphilitic ulcer suggests there may be some relation between it and the later leukæmia. I would venture here to refer to a paper which Moos and myself published in the *Berliner Med. Wochensch.* (No. 19, January, 1885),¹ in which alterations in the spongy portion of the temporal bone were ascribed to tertiary syphilis, and emphasis was laid on the disturbing influence which this disease exercises upon the composition of the blood. We have not yet learned the nature of mixed leukæmia, in which we find alterations in the bony medulla simultaneous with tumors of the spleen, liver, and enlarged lymphatic glands. Some authors are inclined to see in this, too, an infectious disease.¹ But in this

¹ "Beitrag zur Genese der Syphilis Kachexie."

² Ziegler: "Lehrbuch der Pathol. Anat.," 1885, Band ii., p. 18.

point of view we should have to reflect that *several infections might combine to produce the symptomatology of mixed leukæmia*. Such a combination would just suit Politzer's patient, since before contracting syphilis he had a long and severe attack of intermittent fever, which lasted an entire year, and was accompanied with œdematous swelling of the feet and abdomen. If now in this case we could hold the syphilis responsible for the myelogenic leukæmia, and the malarial poison responsible for the lienal form, we should be able to get a little better idea of this enigmatical disease. It is not to be denied that all the other cases of leukæmia combined with aural disturbances so far reported, offer no further support for such a view as this, yet in some of these cases the type was simply lienal. Nevertheless it would be proper in the future to inquire particularly about syphilis when investigating the history of every leukæmic patient.

A CASE OF CARCINOMA OF THE EAR, HAVING
ITS ORIGIN PROBABLY IN THE TYMPANUM
OR MASTOID ANTRUM.

By GORHAM BACON, M.D., AND A. T. MUZZY, M.D.

(With one wood-cut.)

The patient, Mrs. Sarah M., widow, aged fifty-six years, came to my clinic at the New York Eye and Ear Infirmary, August 3, 1887, and was seen by Dr. Muzzy, who obtained from her the following history: She has always been healthy; no history of syphilis nor rheumatism; she has had seven children. A year ago she first noticed the deafness in the right ear, with some tinnitus. There was no discharge until March, 1887; but since then there has been a slight watery oozing. Three weeks ago she noticed some swelling in front of the ear, and the pain which before occurred only occasionally has now become steady. What alarms her, and has brought her here for treatment, is the facial paralysis which followed the swelling.

An examination shows considerable induration and swelling of the tissues in front of the right auricle, and extending towards the orbit and upwards. The swelling also extends below the ear towards the angle of the jaw. There is more or less tenderness on pressure, just in front of the external auditory meatus, and she complains of a steady, boring pain at a point slightly above and in front of the commencement of the helix. This pain is worse at night, not allowing her to sleep. The facial paralysis is not complete. There is a slight sero-purulent discharge from the auditory canal; the walls of the latter are so indurated and swollen that a view of the membrana tympani cannot be obtained. A probe introduced carefully enters to the usual depth, causing no pain, but considerable hemorrhage.

Wet-cups were applied, and she was directed to syringe the ear frequently with hot water. She was also given hydrarg. bi-chlorid., gr. $\frac{1}{4}$; and potas. iod., grs. x., three times daily.

August 23d.—The swelling about the ear seems less, and the pain has almost disappeared.

August 26th.—The pain has recommenced, and it is as severe as before. The swelling remains the same as when first seen. There being some indication of fluctuation, an exploratory incision, one half inch long and one and a quarter inches deep, was made, under cocaine, just in front of the external meatus. No pus was found, and very little bleeding ensued.

August 30th.—The incision has completely healed.

September 13th.—She has a severe erysipelatous ulceration of the right leg. No change in other symptoms. She was given a lead wash for the leg.

October 1st.—Since September 13th she has been at her home in New York State. She feels badly, and thinks while there she overworked. The leg healed quickly. She sleeps only little at night, but dozes during the day. The bottom of the external auditory canal was seen for the first time to-day, and found to be occupied by two dark bleeding vegetations. The mixed treatment was discontinued, as she was suffering from diarrhœa.

October 25th.—The facial paralysis has been complete for the past two weeks. The swelling has increased, and the pain is intense. Poultices have been applied over the temporal and mastoid regions. Antipyrine has been tried in doses of 20 grs. at night, with but slight and doubtful effect.

For the preceding notes I am indebted to Dr. Muzzy, who treated the patient up to this time.

I saw her for the first time about Nov. 2d. She could then hear loud voice with the right ear, and the tuning-fork, when placed on the vertex, was also referred to the same ear. She heard the tuning-fork louder when placed on the mastoid process than by aerial conduction. The left membrana tympani dull, retracted, and thickened; cone of light small. The tissues over the mastoid process were indurated, and on making firm pressure over the apex of the mastoid, there was some deep-seated pain.

I made a Wilde's incision about one and a half inches long and found denuded bone and an irregular opening about one fourth inch in diameter leading to the mastoid cells. There were found

no sequestra of bone nor pus ; the cells seemed covered by a spongy tissue, but a thorough examination was impossible, as probing caused considerable pain. A poultice was then applied over the mastoid process and the ear syringed and morphine given to alleviate the pain at night.

The patient entered the Infirmary as an inmate Nov. 8th, as the pain continued to be severe and the swelling remained the same. Dr. A. H. Buck and Dr. R. F. Weir saw the case in consultation with me, and it was decided best to postpone any operation on the mastoid at present, as a Wilde's incision had already been made and an opening established to the mastoid cells. Although the possibility of its being a malignant disease was considered, it was thought more probable to be a case of extensive caries, involving the mastoid cells and auditory canal, with chronic inflammation and induration of the surrounding tissues. At the time of this examination the probe passed into the mastoid process towards the antrum to the depth of two inches. The probe entering the tympanic cavity also revealed carious bone. The canal was still very much contracted, and the introduction of the probe into the middle ear at this examination, as before, caused considerable hemorrhage. There being some cheesy material in the tympanum, it was deemed best to syringe the ear and the mastoid cells with a solution of boracic acid several times a day, in order to keep the parts thoroughly clean and to continue the morphine to relieve the pain. This treatment was carried out for from ten days to two weeks. As the pain continued and there was no change in the induration of the tissues, etc., with Dr. Buck's concurrence, I decided to explore more thoroughly the mastoid cells.

Operation.—Ether given by the house-surgeon, Dr. Whiting, and assisted by Drs. Richards and Muzzy, I enlarged the incision, which I had previously made, by extending it upwards to a level with the upper border of the pinna and downwards as far as the lower extremity of the lobule. The incision was made half an inch behind the insertion of the pinna. The tissues divided were as dense as cartilage. The mastoid was found extensively diseased, containing loose sequestra of bone and soft tissue. These sequestra and spongy tissue were removed and the cavity scraped with a sharp spoon, so that I was able to introduce easily the little finger into the mastoid cavity.

I cut off a slice of the cartilage-like tissue over the mastoid

process, for microscopical examination. The mastoid cavity was then thoroughly washed out with a solution of carbolic acid, the water syringed in, passing readily through the antrum and escaping by the external meatus and *vice versa*. Iodoform powder was insufflated and a bandage applied. The patient stood the operation well.

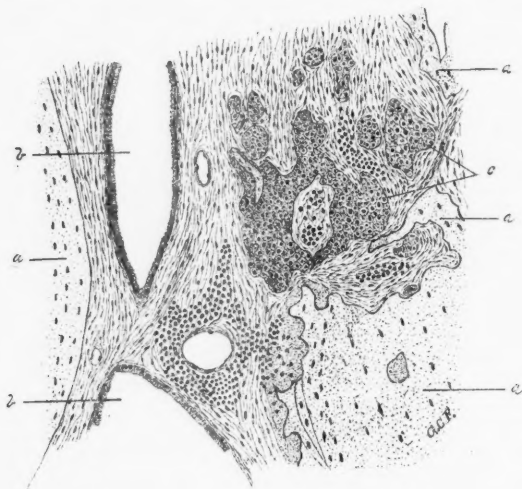
Dec. 15th.—The wound was dressed on the second day after the operation, and a drainage tube inserted in the mastoid cavity. The syringing with carbolic acid solution has been carried out twice a day, and iodoform powder insufflated. There has been much difficulty in preventing the sinus from closing. She has been taking pills of iron, strychnia, and quinia, besides milk and a nourishing diet. Since the operation the pain has been much less severe, but some morphine at night has been necessary.

The slice of indurated tissue removed at the operation was examined by Dr. Richmond Lennox, pathologist to the Infirmary, and pronounced carcinomatous without any possibility of doubt. He says in his report: "It is of the fibrous or scirrhus variety, and as yet the groups of cells characteristic of such growths are small. But it is very distinct, and although in some places there is a moderate amount of cellular infiltration (leucocytes), there seem to be no signs of any breaking down."

Dec. 20th.—The patient has been sitting up during the past week or ten days. The induration about the ear has increased until at present it extends upward two inches and forward towards the orbit two and a half inches; also behind the auricle two inches and downward, just below the angle of the jaw, where there is some enlargement of the glands. The pain that she complained of before the operation, at a point close to the commencement of the helix, seems to be less now. The incision made behind the ear is healed, except where the drainage tube enters, and the entire mastoid cavity is filled with hard tissues, with the exception of the canal maintained by the tubing, which extends forward and inward for a distance of one inch and three quarters, at the lowest extremity of which is observed a slight pulsation. The entire auricle is now indurated except the helix, the fossa of the helix, and the lobule. The cicatrix behind the ear is bluish in color, as well as the meatus and concha. The meatus is contracted still, and a probe passed in for a distance of two inches causes considerable hemorrhage. H. D. watch, R. E. 6"; L. E. 14". When the watch is placed on the right temple, she hears it slightly. The tuning-fork, when held in the same region, is likewise heard faintly with the right ear, but is not heard when

placed on the mastoid process or other parts of the cranium. She hears slightly raised voice with the right ear, when the left is closed, and the tones of a Galton whistle are heard fairly well at a distance of three feet. Left ear: she hears the tuning-fork better by aërial than by bony conduction. She has been up, walking about the room, for the past fortnight, and to-day left the Infirmary for her home.

Feb. 22d.—Dr. Muzzy sent me to-day the following additional notes of the case: The patient has not left her bed since going home. The pain is now great in the upper temporal region and vertex. The pinna has become swollen to a great size, and is of a black color. The meatus is dilated. The cut behind the ear is nearly healed. A large swelling now exists below the ear on the neck. She swallows with difficulty only strained oatmeal. She has hemiplegia of the right side. Her speech is affected and her mind wanders. The mass of the tumor is soft to the touch.



a. Bone trabeculae.

b. Mastoid sinuses.

c. Carcinoma.

FIG. I.—This represents a section made from a portion of the bony tissue removed, during the operation, from the mastoid cells, for which, as well as for making the drawing of the same, I am indebted to Dr. George C. Freeborn.

April 20th.—I received information to-day that the patient died March 24th. For three weeks before death she experienced great difficulty in swallowing, as the disease extended to the neck, and she suffered greatly from nausea and vomiting. Death was due to asthenia. There was no autopsy.

ON THE FUNCTION OF THE COCHLEA.

BY S. MOOS AND H. STEINBRÜGGE.

Abstract by H. KNAPP.

UNDER the above title the authors defend (in a communication of four pages) their belief in Helmholtz's theory of the sensations of sound. Their communication, "Nerve Atrophy in the First Cochlear Convolution; its Physiological and Pathological Importance," published in these ARCHIVES, vol. x., 1, was criticised by E. M. Stepanow in No. 4 of the *Monatsschr. f. Ohr.*, 1886, on the strength of the functional examination of a case of exfoliation of the upper turn and a half of the left cochlea. The authors point out that the examination of Stepanow's case was not accurate enough to demonstrate the absence of a tone defect in one ear of his patient. The patient was utterly unmusical, his statements were contradictory, and it is clear that he may have referred to his bad ear what, in reality, he heard in his good. The authors consider it possible that the membranous parts of the labyrinth and their functions may, to a certain degree, be preserved after the exfoliation of the necrosed bone. During the slow exfoliation new formations of bone may take place and protect the soft tissues.

THE PUPILS IN THE DEAF-MUTE INSTITUTION OF LUDWIGSLUST, MECKLENBURGH.

BY DR. CHR. LEMCKE, OF ROSTOCK.

Abstract from the German edition, vol. xvi., pp. 1-30, 1886, by Dr. H. KNAPP.

AMONG the results of the author's examinations of the 72 pupils of Ludwigslust the following appear as the most important.

The total number of deaf mute pupils in the institution was 72.

Of 35 deaf-mutes, belonging to 30 families, it was ascertained that neither parents, nor grandparents, nor relatives had been deaf-mute.

Eleven pupils of 7 families, in which deaf-mutism has not been noticed, had deaf-mute brothers or sisters. In these 7 families there were 19 deaf-mute children, 8 not being in the institution.

In 37 cases out of the 72, the deaf-mutism was acquired. It was caused by the following diseases:

1. Scarlet-fever in 35.13 %.
2. Brain affections in 24.32 %.
3. Ear affections in 13.51 %.
4. Typhoid fever in 5.40 %.
5. Measles in 5.40 %.
6. Injury of the head, lues, convulsion in teething, cold, each in 2.70°.

The auricles were monstrously enlarged in 3 cases, deformed like the so-called cat's ear in 1.

Twenty per cent. of the pupils were absolutely deaf for all sources of sound.

As in other statistics the male sex predominated over the female, viz: 100: 75.6; (Hartmann, 100: 85.1; Schwartz, 100: 85.6.)

Children of poor parents prevailed over children of rich parents.

Two thirds of the 37 cases (51.39%) of acquired deaf-mutism contracted the disease in the first three years of their lives. Scrofulous diathesis was a prevailing cause.

Pathological changes in the drum-head were found in 43% of all the cases. Chronic laryngeal catarrh was very frequent.

Measurements of the head showed that the skulls of the deaf-mutes were notably reduced in all their diameters when compared with the skulls of healthy children of the same age.

REPORT ON THE PROGRESS OF OTOTOLOGY
DURING THE FIRST HALF OF THE
YEAR 1887.

B.—PATHOLOGY AND THERAPEUTICS.

By A. HARTMANN, BERLIN, and ED. SCHULTE, MILAN.

Translated by Dr. MAX TOEPLITZ, New York.

(Concluded.)

28. MIOT, C. Remarks on the obstruction of the Eustachian tube in a diabetic patient. (Réflexion sur l'obstruction de la trompe chez un diabétique.) *Société franç. d'otologie*, April 15, 1887.

29. ATKIN, CHARLES. Persistent vomiting as a cause of ear trouble. *Brit. Med. Journ.*, 1887, p. 327.

30. COUSINS, JOHN WARD. Tinnitus aurium and its treatment by a new method of alternate injection and evacuation of air. *Brit. Med. Journ.*, 1887, Nos. 1365 and 1369.

31. BARACZ, ROMAN VON, Lemberg. Excision of the drum-head and hammer in sclerosis of the mucous membrane of the tympanic cavity. *Wiener med. Wochenschr.*, 1887, Nos. 10 and 11.

32. BEZOLD, F., Munich. On the treatment of otorrhœa with boracic acid, and the objections that have been raised to it. *Deutsch. med. Wochenschr.*, 1887, No. 8.

33. DALBY, Sir WILLIAM B. On the management of perforations of the membrana tympani. *Brit. Med. Journ.*, 1887, No. 1367.

34. BUCK, ALBERT H. Chronic catarrhal inflammation of the middle ear. *Med. Record*, January 1, 1887.
35. POMEROY, OREN D. Case exhibiting the results of multiple paracentesis of the drum membrane on hearing in chronic aural catarrh. *N. Y. Med. Journ.*, Feb. 12, 1887.
36. RICHEY, S. O. A contribution to the management of general atrophy (sclerosis) of the conducting apparatus of the ear. *Amer. Journ. Med. Sciences*, April, 1887.
37. SCHULTE, ED., Milan. An unfavorable consequence of instillation of alcohol into the tympanic cavity. (Una conseguenza sfavorevole delle intillazione di alcool nella cassa del tympano.) *Bollet. delle malattie dell' orecchio*, etc., 1887, No. 1.
38. LANGE, VICTOR. Some remarks on the application of lactic acid in chronic purulent otitis media. (Einige Bemerkungen über die Anwendung von Milchsäure bei chronischer eitriger Mittelohr-Entzündung.) *Monatsschr. f. Ohrenheilk.*, etc., 1887, No. 3.
39. BETTMAN, BOERNE. A case of purulent inflammation of the ear with brain complications. *Jour. Amer. Med. Assoc.*, Jan. 1, 1887.
40. KELLER, CARL. A case of mastoiditis. (Zur Casuistik der Warzenfortsatz-Erkrankungen.) *Monatsschr. f. Ohrenheilk.*, etc., 1887, No. 4.
41. BARGEZ. Three cases of trepanation of the mastoid process. *Przeglad Lekarska*, 1887, No. 4.
42. WILLIAMS, CHARLES. Cases of trepanation of the mastoid process. *The Lancet*, 1887, i., p. 974.
43. BARR, THOMAS. Separation by necrosis of the osseous labyrinth of the right ear, and its removal as sequestrum from the auditory canal. *The Lancet*, 1887, i., p. 212.
44. MCBRIDE, P., and MILLER, A. G. The diagnosis and treatment of cerebral abscess due to ear disease. *The Edinburgh Med. Journ.*, 1887, May and June.
45. BARKER, ARTHUR E. Cerebral abscess due to disease of the temporal bone, and its treatment. *The Lancet*, 1887, No. 3328, p. 1175.
46. BARR, THOMAS. Abscess in the brain resulting from disease of the ear. *Brit. Med. Journ.*, 1887, p. 723.
47. WEIR, ROBERT F. On the surgical treatment of brain

suppuration following ear disease. *Brit. Med. Record*, April 9, 1887.

48. GREENFIELD, W. S. Remarks on a case of cerebral abscess, with otitis successfully treated by operation. *Brit. Med. Journ.*, 1887, No. 1363, p. 317.

49. MACEWEN, W. Case of cerebral abscess due to otitis media. *The Lancet*, 1887, i., p. 616.

50. VOLTOLINI. Otitis media, polypus in the middle ear, meningitis, etc. (Otitis media, Polyp im Mittelohre, meningitis, etc.) *Monatsschr. f. Ohrenheilk.*, etc., 1887, No. 2.

51. DÉLIE D'YPRE. Otorrhœa with complications. (Otorrhées compliquées.) *Société franç. d'otologie*, etc., April 14, 1887.

52. POOLEY, THOMAS R. Double optic neuritis and Ménière's disease. *N. Y. Med. Journ.*, Jan. 8, 1887.

28. MIOT states that diabetics suffer at times from ear troubles of varying intensity and duration, which are caused by swelling of the Eustachian tube. Some of the cases are curable; in the others the tubes are permanently obstructed, the passageway being impermeable both for the air or for bougies. The constant current allays the congestion of the mucous membrane, and renders possible the introduction of bougies and the application of the chemical and galvanic cauteries.

29. ATKIN reports two patients with persistent vomiting (one with locomotor ataxia), in both of which particles of the vomited masses entered the tubes and caused ear symptoms which are usually observed in stenosis of the Eustachian tube. S.

30. Where the tinnitus depends upon restricted mobility of the ossicles and the drum membrane, the author tries to restore the mobility by alternate injection into, and evacuation of air from, the tympanic cavity. The apparatus employed for this purpose consists of two rubber balls, which serve respectively for the rarefaction and condensation of air. They are connected by an india-rubber tube, with a special nasal piece, for hermetically closing the nose. After the instrument has been inserted into both nostrils, the patient is directed to take a full inspiration, and then, while holding firmly the breath and pressing the lips together, to perform an expiratory movement. In recent cases, considerable relief is obtained at one sitting, but in chronic cases the operation should be repeated two or three times weekly for several weeks.

31. In consideration of the poor results from all other meth-

ods of treatment in sclerosis, BARACZ determined to perform the excision of the drum membrane and the malleus in such a case, an operation which was frequently done by Lucæ and Schwartz. The operation was followed by a sero-purulent discharge of short duration. The noises disappeared entirely; the hearing was not changed. The patient felt considerably better. The opening in the membr. tympani remained permanent. The operation was done a year ago. Lucæ has performed this operation fifty-three times; Schwartz six times. The former found the hearing impaired only in seven cases, but unchanged in the others, or even more or less improved. The subjective noises were never intensified by these operations, on the contrary, often lessened, and in one case they disappeared entirely.

32. Although Schwartz has declaimed formerly as now at the meeting of the naturalists in Berlin, against the treatment of purulent otitis media with powdered boracic acid, Bezold, nevertheless, believes in this treatment. The beneficial results obtained by it in the greater number of cases are confirmed by his own experience and that of others. He excepts those rare cases in which the inflation of boracic acid into the widely-opened tympanic cavity is followed by copious serous discharge and intense pain, and those in which the integument of the external meatus shows a still greater reaction. Although the small perforations of Shrapnell's membrane, when treated with boracic acid, are followed by a fatal result, yet it should be remembered that the prognosis in such cases is an unfavorable one anyhow. Within three years Bezold observed the fatal termination of three cases of perforation of Shrapnell's membrane among thirty-seven cases of this form. He proves that death could not have resulted from the treatment. The author treated almost all cases of otorrhœa with perforation of Shrapnell's membrane with boracic acid, which was blown even through the curved Eustachian tube directly into the tympanic cavity; the mortality in these cases amounted only to 0.8 per cent. He observed frequently that boracic acid not only does not hinder the discharge of pus, but even favors it by imbibition. Bezold considers iodoform powder also indispensable, but, on account of its insolubility it should be only inflated in very small quantity. Whether or not packing of the external meatus with powdered boracic acid may produce bad effects by retention of secretions, can only be decided by statistics of a great number of cases of suppurative otitis.

Bezold does not believe that the mortality of 0.8 per cent., with his treatment, exceeds that of any other method. It will be often remarked that the discharge is favored rather than impeded by the boracic acid covering the perforated drum-membrane.

33. From the fact that the majority of perforations of the membrana tympani during infancy heal without any treatment whatsoever, it does not follow that nothing should be done for these perforations. But they are better without treatment than under treatment with mineral astringents. Careful cleansing, together with the air-douche, and applications of vegetable astringents, should be employed. Alcohol, iodoform, and boracic acid have, in some cases, a beneficial influence upon the secretion, but in others they are decidedly irritating. The "behavior of a perforation," under the employment of the artificial drum-membrane, varies greatly; this is illustrated by the following case: A patient wore for fourteen years a cotton-wool wad as an artificial drum-membrane, with beneficial result. The hearing became worse in spite of the cotton. It was found that the perforation was closed. After it was re-opened, the patient heard with the artificial drum-membrane as well as before. The author concludes that no general rules can be laid down, but it should be observed in every particular case what treatment will give the best result.

34. BUCK is of the opinion that catarrhal inflammation of the middle ear proceeds mostly from the same condition in the nasopharynx, and believes that remedies addressed to these parts alone will, in the majority of cases, effect greater improvement than treatment to the ear itself. As to the cause of these pharyngeal troubles, he thinks the most important are: smoking, the American craze for fresh air in bedrooms, and a gouty tendency. When the process has gone on to sclerosis of the mucous tissues, he deems it incurable. For local applications to the pharynx, he prefers nitrate-of-silver solutions made by means of absorbent cotton on a probe. For cleansing the nose from the cheesy matter collected in its cavities, he uses a spray of listerine, 1 to 4 of water. The lithæmic condition must, of course, be properly treated.

SWAN M. BURNETT.

35. POMEROY reports the histories of twenty-four cases of chronic aural catarrh, treated by multiple punctures of the drum-head. There was a decided improvement of hearing in both ears in eleven cases; there was considerable gain in hearing in

one ear in three cases. He believes the operation as justifiable and free from danger.

SWAN M. BURNETT.

36. In this paper RICHEY gives more details for the management of cases of dry catarrh, according to the method explained by him in his paper in these ARCHIVES, No. 1, vol. xv. In applying the vapor of iodine to the drum cavity, through the Eustachian tube, he uses a constant stream of air, obtained through the hydraulic automatic air-pump, such as is used for furnishing air-pressure to beer barrels. He finds this apparatus, which can be easily attached to the water-pipes of residences, to be very convenient and efficient.

S. M. B.

37. SCHULTE reports a case, in which instillation of absolute alcohol in otorrhoea was followed by paralysis of the sense of taste on the anterior two thirds of the corresponding side of the tongue, causing, namely, a paralysis of the chorda tympani.

38. LANGE, in chronic suppuration of the middle ear uses instillations of lactic acid of 15 to 30 per cent., with good result, inasmuch as very soon after the application the secretion promptly diminishes and the offensive odor is destroyed. The remedy has no effect upon dense granulations.

S.

39. The peculiarities about BETTMAN's case are, that the otitis was acute and had been treated for several days by an almost constant application of hot water. The relief to all the unpleasant symptoms was immediate on the application of ice-bags to the mastoid. No other treatment was instituted.

S. M. B.

40. KELLER gives the history of a case of otitis media complicated by periostitis of the mastoid process, which made further progress even after paracentesis of the drum-membrane and after subsiding of the middle-ear process, until a great deal of pus from a subperiosteal abscess was released by an incision over the mastoid.

S.

41. BARGEZ' first case was a trauma of the right ear, followed by suppuration of the middle-ear with formation of polypi in the external meatus. An abscess formed below the auricle, facial paralysis and caries of the mastoid process developed. After removal of a sequestrum the author found a whitish mass, which he considered to be brain substance; the finger felt pulsation. The removed granulations represented whitish masses, which were recognized by the microscope as belonging to the outer layer of the brain substance. Complete recovery. In the second

case the excision was extended very high upwards on account of the position of the sequestrum, which required great care, in order to avoid exposing the cranial cavity. Recovery. The third case is remarkable by the fact that during the operation the necrosed wall of the transverse sinus had to be removed. No hemorrhage. Patient left Lemberg a month after the operation.

SREBERNY (Warsaw).

42. WILLIAMS reported two cases of trepanation of the mastoid process "post otorrhœam," and one case, operated for peritonsillitis of the mastoid, which were permanently cured of the unbearable pain in this region. S.

43. The sequestrum removed by BARR consisted of the whole osseous labyrinth with its three divisions. The vestibule, the semicircular canals, and the osseous cochlea were easily recognizable. There was paralysis of all facial muscles before removal, and the face was drawn to the left. The right eye seemed lower than the other. When closed, the sclerotic below the cornea remained uncovered. No cerebral complications. S.

44. MCBRIDE asserts that we can in most cases diagnose sinus-phlebitis by the presence of pyæmic symptoms and by local manifestations. If the lateral sinus is involved, the region of the jugular vein will be found tender, but if the cavernous sinus is implicated, we find optic neuritis and exophthalmus at a later stage. Excluding sinus-phlebitis, the diagnosis may lie between meningitis or localized abscess, the situation of which is supposed to be behind the tentorium, if bone-conduction is lost. The usual seat of the abscess is near the roof of the tympanum. We cannot in most cases distinguish between meningitis and localized abscess. The point chosen for opening the skull should always be just above and in front of the osseous meatus. It saves life in a number of cases and may possibly benefit even some in which the suppuration is diffuse. The operation should only be undertaken when the presence of pus behind the tentorium is certain. MILLER's communication tends to prove that optic neuritis, low pulse and temperature, render the existence of a brain abscess probable, and that in case of an operation a diseased portion of the dura mater and of the bone might be removed and the arachnoid space washed out, as the pus therein becomes the source of the septic absorption. S.

45. In the statistics of R. Meyer and Ogle twenty-nine of one hundred and one cases of cerebral abscess were due to dis-

ease of the temporal bone. BARKER considers 30 per cent. to be below the mark, and thinks it would be probably nearer 50 per cent. The inflammation extends from the ear into the brain in two ways: 1, by a phlebitis, and 2, by direct extension to the dura mater. The main obstacle to the operation is the difficulty in making an accurate diagnosis. We must first effect a free discharge of secretion from the middle ear. If then the symptoms do not disappear, an opening should be made into the mastroid. Subdural abscess will be found either on the roof of the tympanum or in the region of the sinus. These spots should therefore be first opened. Real abscesses of the brain are comparatively rare, but they are far more common in the cerebrum than in the cerebellum. The cerebellar abscesses are always found at the outer and anterior portion of the cerebellum near the petrous portion of the temporal bone. Since these parts of the brain are tolerant of surgical measures and their function is still obscure, the clinical symptoms are the guide for the localization of the process.

But other symptoms are of value for the diagnosis: Weakness, subnormal evening temperature, and "*the sluggish but perfect cerebation.*" Neuritis optica, taken with other signs, is a valuable symptom.

46. BARR'S exceedingly interesting paper on brain abscess consequent to otorrhœa gives us, besides the many other important observations, the statistical result, that the number of deaths in London attributed to brain abscess following otorrhœa in one year was eighty-six, and in the eight principal towns of Scotland in the same period of time was twenty-six. In one of his seven cases where post-mortem examinations were made by the author, complete occlusion of the lateral sinus by fibrous bands was found; in another pus was discovered between the dura mater and the bone, over the posterior surface of the petrous part of the temporal bone. In all cases the odor from the abscess was extremely foetid and the pus of a greenish color, and in three the abscess was limited by a membrane. Among seventy-six cases collated from literature, the abscess was in the middle lobe in fifty-five cases, in the cerebellum in thirteen, in the cerebrum and cerebellum in four, in the pons Varolii in two, and in the crus cerebelli in two cases, the abscess being encysted in nine cases. The author explains the main directions by which the suppuration extends from the primary seat to the abscess, and shows

that among his seven cases caries existed in five. He concludes that if every physician were sufficiently impressed with the importance of suppuration of the middle ear, and prepared to treat this disease in all its stages, the occasion for the operation would probably seldom arise. S.

47. WEIR'S case was a woman thirty-nine years of age, who had an injury of the thumb going on to suppuration, and shortly afterwards purulent otitis media, with brain complication. The mastoid was opened by drill and chisel, and some pus evacuated. Afterwards the brain trouble increased, and an exploratory puncture of the brain was made through the opening in the mastoid, but no pus was found. Matters still getting worse and optic neuritis showing itself, the skull was trephined over the left Roland-eric line and exploratory puncture made. The patient died next day and no autopsy was obtained. SWAN M. BURNETT.

48. A patient, twenty-six years old, was brought to the author's ward in a semi-comatose condition. He began to suffer from cough and cold in the head ten weeks before, and at this time, for a few days, he complained of deafness in the left ear. In three weeks he recovered, then for a month was fairly well, and then began to suffer from headache and persistent vomiting. Ptosis set in on the left eye ; abnormal dilatation and immobility of the pupil and optic neuritis. There was subnormal temperature, the tongue deviated to the right ; no other paralyses or symptoms of irritation were found. The skull was opened on the supposition of the existence of an abscess in the temporo-sphenoidal lobe. The exposed dura mater, which bulged out at this place, was incised. About two ounces of pus escaped. A drainage tube was introduced and the ear irrigated with a solution of boracic acid during the subsequent days. The day after the operation the patient was much more intelligent, and his sensorium improved very rapidly. The tube was removed on the fifteenth day after the operation, and the wound closed completely two days later. There existed only a sensation of heaviness in the forehead and the eyes and a tendency to sleep. The author believes that the abscesses dependent upon ear disease, are usually located in the middle lobe of the brain.

49. MACEWEN'S observation treats of an abscess of the temporo-sphenoidal lobe due to septic otitis media. The condition of the lateral sinus was doubtful, but the operation was undertaken and resulted in a complete cure. S.

50. The title of VOLTOLINI'S communication is : " Otitis media—Polypus in the middle ear—Meningitis—Chronic abscess of the brain—Cholesteatomatous masses in the mastoid antrum—Death—Autopsy—The diagnosis and treatment of cerebral abscess." In the latter part of this paper the author advises in cases where brain abscess is suspected, to cautiously employ the electric current to the head, in order to see how patients with brain abscess react. S.

51. DÉLIE reports cases of complications in suppurative otitis media. Two cases of abscess over the mastoid, one of caries and one of necrosis of the same region. In his fifth case death ensued under meningitic symptoms. A post-mortem examination was not made.

52. POOLEY'S case was a blacksmith of thirty-four years, who had had various indefinite symptoms as to his nervous system, eyes, and ears for some time. He had a typical seizure of Ménière's disease, and remained perfectly deaf, with extreme dizziness, until death. Pooley found a double neuro-retinitis, which had all the characteristics of retinitis albuminuria, though the most careful and repeated examination of the urine failed to discern casts or albumen. The post-mortem examination revealed, however, the fact that both kidneys were congested, and one rather larger than the other. The brain was exceedingly soft. No tumor or extravasation was found. Pooley is inclined to think that, in spite of the lack of the usual evidence to establish a diagnosis, albuminuria was the cause. S. M. B.

NOSE AND NASO-PHARYNX.

53. BRESGEN, MAXIMILIAN. Brief notes on swelling of the nasal mucous membrane in persons occupying the lateral position. *Deutsche med. Wochenschr.*, 1887, No. 17.

54. NOQUET, Lille. Some observations on atrophic rhinitis. (Quelques considérations sur la rhinite atrophique.) *Société franç. d'otologie*, April 15, 1887.

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76. CALMETTES, R. On the operation of adenoid vegetations of the naso-pharynx. (Opération des végétations adénoïdes du pharynx nasal.) *Gaz. méd. de Paris*, 1887, p. 276.

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78. RUVAULT, ALBERT. Contribution to the study of hypertrophied tonsils. (Contribution à l'étude des hypertrophies amygdaliennes.) *Union méd.*, 1887, May 26th.

53. BRESGEN argues against the general belief that the swelling arises from the simple settling of blood. He thinks that it depends on nervous symptoms, which should excite further investigation.

54. NOQUET treats of the development and treatment of rhinitis atrophicans from his own observation of thirteen cases.

The offensive odor and the collection of crusts are found more in younger individuals. Both decrease with increasing age, so that the spontaneous recovery, already asserted by Trousseau, takes place in old age. There existed aural affections in all patients over twenty years of age. Viscous masses of mucus were found in young individuals, dry crusts in older ones. A cure could be effected by long-continued treatment. Noquet uses the nasal douche with solutions of soda twice a day, after which he sprays with a fluid consisting essentially of boracic acid. Further, the spray is employed at noon with antiseptic vinegar. Noquet himself brushes the nose twice a week with a solution of zinc chlorate of 20 to 100.

55. SEISS tried for treatment of ozæna solutions of thymol in glycerine and alcohol, and eventually with the addition of water of different concentration. They were applied two or three times a week, after careful cleansing of the nose by means of the atomizer. The results obtained by this treatment are so excellent, that Seiss now uses thymol in almost all cases of ozæna. A complete cure cannot be hoped for under this treatment, but the cases can be more benefited than by any other remedy. The author has found thymol also in aural lesions complicating ozæna to be of beneficial influence. Permanent improvement can only be obtained in from three to nine months, according to the degree of development of the disease. Seiss has entirely abandoned the nasal douche as dangerous.

56. The author answers the much-discussed question concerning the possibility of probing of the frontal sinus, in the affirmative. He has probed in twenty-three uncomplicated cases, on both sides, and in thirteen of these successfully. In a patient with exposed frontal sinus, he saw the introduced probe in the cavity. He used a very delicate blunt metal probe, but believes that whale-bone probes are preferable, on account of the curvatures of the canal. The mouth of the frontal sinus must be looked for in the upper part of the sulcus, formed by the infundibulum between the anterior extremity of the middle turbinated bone and the processus uncinatus. The author hopes that, by perfecting the technique, probing can be carried out in a still greater percentage.

57. BRESGEN observed that the nostril on the deviated side of the septum is, as a rule, lower than the other. He agrees with Ziem that deviations are principally caused by mechanical injury.

Ziem has drawn the attention to the fact that asthenopia, strabismus, and astigmatismus occur with deviations of the nasal septum. The symptoms produced by the deviation are mainly due to the presence of secondary rhinitis. The best treatment for deviations are the chisel and chromic acid, the latter only in the cartilaginous, both alternately in the osseous form. The author prefers, for the treatment of osseous deviations, the use of chromic acid of 20 to 40 per cent. He considers this treatment "safe," but "very tedious and slow."

58. The greater number of the nasal septa are more or less deviated. It has not been decided as yet, whether they deviate the more frequently to the right or to the left. In extensive deviations the nose has, furthermore, often an unsymmetrical appearance. Welcker is of the opinion that with the deviation of the septum there exists an inequality of the nostrils and asymmetry of the nasal bones, the hard palate, and the orbits. From this and his own observations SCHAUSS concludes that the trauma does not play the important part in the etiology, generally attributed to it, and that irregularities of development must be the principal cause.

59. MEYERSON's patient, a woman 37 years of age, was a mouth-breather. After a rhinoscopical and digital examination of the naso-pharynx, he found the posterior nares closed by a membrane, which, arising from the lower margin of the posterior nares, lined the lateral walls and the roof of the naso-pharynx. The membranæ tympani were dull and retracted, hearing somewhat diminished. The treatment consisted in burning an opening into the membrane with the galvano-cautery, shaped like a catheter, which was introduced anteriorly into the right nostril. The opening was then dilated with hard-rubber sounds. The author introduced his finger into the naso-pharynx three days later, when the opening was large enough, and removed the whole membrane. Nasal breathing was completely restored.

SREBERNY (Warsaw).

60. HUBBELL's patient, a young man eighteen years old, showed, after birth, all the symptoms of mouth-breathing. There was a loss of smell and free mucous discharge from the nose. The senses of taste and hearing were acute. The membranæ tympani were normal and the Eustachian tube was freely permeable. Rhinoscopic examination was impracticable. The mucous membrane of the nose and its cavities was swollen and congested.

Digital exploration of the naso-pharyngeal cavity revealed two conical depressions separated by the posterior border of the vomer. In the inferior meatus on either side a firm and complete obstruction was met to a depth of 5 *cm*. A trocar was passed on one side and the occlusion was found to be a thin, bony plate lined on both sides with mucous membrane. Large openings were made by the drill on either side and kept open with sounds and tents, but they were found contracted again two months subsequently to the operation. The success of the second operation with the drill was secured by the insertion of tubes made of "block tin," their diameter being 10 *mm*, which were kept in the opening for six weeks. Hubbell collates seventeen cases from the literature, and analyzes them carefully. The bony obstructions develop always from the perpendicular or horizontal plate of the os palatinum, or both, to be united with the sphenoid above and the vomer or the opposite fellow, at the median line.

M. TOEPLITZ.

61. MCBRIDE concludes from the view which he at present holds on nasal reflex, that asthma, megrim, neuralgia, epilepsy, etc., may occasionally owe their origin to nasal disease. The cure of a neurosis by treatment of the nose does not necessarily prove its nasal origin. Cauterization of the nasal mucous membrane may simply act as a counter-irritant, since these neuroses have been cured by applications of the cautery to the normal mucous membrane and even to the back of the neck. The cases, in which good results have been obtained by cauterization of the lobule of the ear, by dilatation of the cervix uteri, amputation of the clitoris and of the scrotum, etc., belong to the same category.

62. Most authors are now inclined to believe, that epistaxis depends principally upon a local lesion, which is mostly found at the anterior portion of the nasal septum as a somewhat deepened excoriation covered by a small brown or black crust of the size of a poppy or millet seed (sometimes a lentil), as described by Chiari. In the above-mentioned policlinic there were found thirty-seven of fifty-four patients, where the seat of the lesion was almost exclusively at the anterior portion of the septum. Hartmann agrees with Chiari, that the bleeding is caused here by the direct exit of the vessels from the bone, whereby the vessels remain open after injury. The treatment consisted, besides plugging during the bleeding, in cauterization with nitrate of silver and in the application of the galvano-cautery. The

excellent results attained by this treatment prove the accuracy of the diagnosis as to the etiology.

63. POOLE simply plugs the posterior nares by means of a catheter, twine, and lint. S.

64. Most authors simply refer to Billroth's view, that the transformation of mucous polypi into malignant tumors must be considered for the time-being as a "myth." But a few investigators have gradually arrived at the belief that such a transformation may take place. The author has obtained a specimen by operation, which confirms the possibility of such a transformation. It is a nasal tumor, having a diameter of 5×2.5 cm, from a patient, fifty years of age. The growth was suspended from the roof of the nose, was ulcerated and granulated in its lower portion, and had the appearance in its upper portion of a simple polypus. After removal of the growth with the snare, the point of exit was completely cicatrized in a few days. The patient was then subjected to the treatment with arsenic, and has not shown any relapse for two years. The microscopical examination of the lower portion of the tumor revealed a carcinoma villosum. The author was lately consulted by a patient, fifty years of age, who had suffered from obstruction of the right nostril for about twenty years, associated during the last two months with pain, yellowish discharge from the right nostril, and general emaciation. BAYER removed carcinomatous masses from the interior nasal meatus, and tumors from the upper parts of the nose, which had the appearance of mucous polypi, but were entirely infiltrated by carcinomatous tissues.

65. LANGE, for the removal of extensive tumors from the naso-pharyngeal cavity, recommends the employment of a blunt hook, which, introduced with the end directed downward, should be applied from above around the neck of the tumor. The author, after an exploratory traction, pushes the tumor with the index-finger into the choana, and at the same time pulling the hook outwardly severs the tumor. S.

66. JACOBSON's patient, a young man seventeen years of age, presented himself with a tumor which pushed out the right cheek, the right eye, and the soft palate, filling the right nostril and crowding over the septum. A tumor of the size of a hen's egg was felt under the malar bone. A piece snared off from the nasal elongation was considered, after microscopical examination, to be a myxo-sarcoma. The tumor was removed from its attachments

with the floor of the orbit, the septum, and the pterygoid plates of the sphenoid bone and its elongation into both nasal fossæ, the antrum, and all adjoining cavities, where it was firmly adherent, by means of Fergusson's preliminary resection of the superior maxilla, preceded by tracheotomy. Its real origin was the body of the sphenoid and the basilar process of the occipital bone, exhibiting a decided pedicle. The tumor weighed four ounces. Dr. Sears pronounced it to be a *fibro-myxoma*. After the operation septicæmia set in, caused by the filling of the wounded cavity with styptic cotton as a precautionary measure against secondary hemorrhage. Continued fever for eight weeks. Acute otitis of the left middle ear occurred during the fourth week, supplanted by an inflammation of the right ear during the seventh week after the operation. The patient finally recovered. The second part of the paper contains a careful review of the literature and a table of twenty-eight cases operated by American surgeons by means of preliminary resection of the upper maxilla.

M. TOEPLITZ.

67. MICHEL describes his electrolytic method employed in four cases of fibrous naso-pharyngeal tumors. He concludes from his experience that even the largest of these tumors can be removed by electrolysis in from six to nine months, provided the tumor is easily accessible to the needles and can be operated upon in six to eight subsequent days of each month at one to two sittings of forty to fifty minutes' duration. S.

68. ZIEM's patient, fifty-four years of age, had an abscess at the left lower lid near the canthus. The second upper left bicuspid was carious. After its extraction a sac was found on its root. The antrum was opened from the alveola; thick pus discharged. The antrum was syringed with antiseptic solutions. Great improvement after a few days. Four similar cases have been observed by Parinaud. Ziem thinks that the suppuration was transferred in his case from the antrum along the blood-vessels, running to the point of the lid described above; but the inflammation may also be transferred from the alveolæ to the lid without the participation of the antrum.

69. When the patient, sixty-five years old, came under Ziem's observation, he had an abscess of the left orbit and a fistula of the lachrymal sac, associated with intense swelling of the lower turbinated body and empyæma of Highmore's antrum. The latter was opened from the alveola and irrigated. The nasal cavity,

the fistula, and the abscess cavity of the orbit were syringed with antiseptic solutions. This produced a complete cure in a few weeks. There was no connection between the antrum and the orbit.

70. DOUTRELEPONT treated a case of rhino-scleroma with sublimate-lanolin of one per cent. The strong, non-syphilitic patient, thirty-four years of age, had been suffering for seven months. The septum, the right ala nasi, and the whole upper lip were infiltrated. After application of the sublimate ointment for four and a half months, and the removal of only a small piece of the upper lip with the sharp spoon, the tumor was so reduced that no pathological lesion save a slight thickening could be detected. The microscopical examination revealed a small-celled infiltration of the corium, principally around the blood-vessels. There were larger cells among them, some of which contained the short bacilli of rhinoscleroma.

71. DITTRICH had the opportunity of examining two cases of rhinoscleroma anatomically. The author agrees with all modern investigators, that rhinoscleroma does not represent a new formation, but a chronic inflammation. Histologically the examined portions showed a dense small-celled infiltration, which in places is finally transformed into connective tissue. Interspersed therein were also found those "hydropic" cells, so called by Mikulicz, large homogeneous cells with a distinct species of bacillus (first discovered by Frisch), and the same bacilli in the interstices of the cells. These cells and bacilli were present in small number in pieces of the tissue taken from recent stages of the rhinoscleroma; in those of later stages their number was markedly increased. Dittrich believes that these cells of Mikulicz develop from ordinary round cells containing first one or two bacilli, which gradually increase in number, whilst the cells grow, the nuclei becoming more and more indistinct, until they ultimately disappear. Finally he supposes that these cells show a necrotic degeneration. In conjuncture with the bacilli cocci occur, which seem to belong to the same bacterial species as the former, because both species could not be separated in cultures. The bacilli appear limited by a membrane when stained in a certain manner, first discovered by Cornil and Alvarez. Dittrich does not consider the pathogeneity of the bacilli to be proven, as the experiments on animals simply resulted, up to date, in the production of inflammation of the serous membranes, of the cell tissue, and of the muscles in mice and guinea-pigs.

72. SCHÄFFER has observed eight cases of nasal tubercle tumors. They were situated on the septum in all cases. They consisted of nodes of the size of a small walnut, connected at the base. After removal of the tumors, ulcers remained, leading to perforation of the septum in three patients. Two of the described tumors were examined anatomically by NASSE. They consisted of granulation tissue with numerous tubercles. Very few bacilli were found. After extirpation the growth has the tendency to relapse. Schäffer cannot express at present a final view on the prognosis.

73. BABER removed a rhinolith from the nose of a patient twelve years of age, who had had a discharge from the left nostril for six years. The left side of the nose and the left cheek were bulged out, and the malar bone was more prominent on that side. S.

74. Trautmann has returned to the old view as regards the etiology of adenoid vegetations, that scrophulosis is the base of this disease. The author believes that the conception "scrophulosis" can be dispensed with, as scrophulosis essentially consists of nasal suppuration. The latter is the cause of the vegetations. Since on all mucous membranes swellings arise from chronic suppuration, it would be remarkable if the mucous membrane of the naso-pharynx should prove an exception. According to his theory and to the analogy with other mucous membranes, ZIEM believes that adenoid vegetations disappear entirely after the removal of the greater part and after treatment of the chronic suppuration. He prefers this treatment because he thus preserves adenoid tissue, to which some physiological function must be attributed.

75. KILLIAN is right to point to the great advantage offered by rhinoscopia anterior in the diagnosis of adenoid vegetations of the naso-pharynx, which is considered also by the reviewer as indispensable in every doubtful case. Swellings of the turbinated bodies obstructing the view of the observer contract by application of cocaine solutions. The author's experience extends over one hundred and fifty-six cases, observed in Arthur Hartmann's polyclinic, and operated during the summer semester of the year 1886. The percentage of ear patients among those affected with adenoid vegetations was 74.18 (Meyer 74.28); 18.46 per cent. of all ear patients had vegetations. Hartmann's curette, used for operation of the vegetations, is a modification of Lange's ring-knife, inas-

much as the part employed at the pharyngeal roof is lengthened conforming to the capacity of this region, and forms an angle with the posterior part, according to the form of a sagittal section of the naso-pharynx in erect position of the head. He thus almost invariably succeeded in removing all tumors at one sitting, repetition of the operation being necessary only in 15 per cent. of the cases. S.

76. CALMETTES, in order to avoid, as has been customary, to operate ten or more times for the removal of adenoid vegetations, chloroforms *à dose maximale*, as he expresses it, and then removes all vegetations found in the naso-pharynx at one sitting. The necessity for so frequent a repetition still remains unproven, as also for the chloroform narcosis *à dose maximale*, since light narcosis suffices for the operation, without arresting the reflex action, which, particularly here, is of value for the prevention of the entrance of blood, etc., into the larynx. S.

77. BRESGEN asserts that even if the operation of adenoid vegetations with the cold snare takes too much time, and is not always applicable, he, nevertheless, did not need postpone the abandonment of the snare until Trautmann's spoon became known. If an accurate operation is not desired, then Lange's ring-knife answers all purposes.

78. RUAULT distinguishes two forms of tonsillar hypertrophy. The first is dependent on chronic inflammation resulting in sclerosis of the connective tissue of the tonsil; the second shows hyperplasia of the lymphatic follicles. The author prefers for the treatment of both forms the actual cautery to the usually employed tonsillotomy. S.

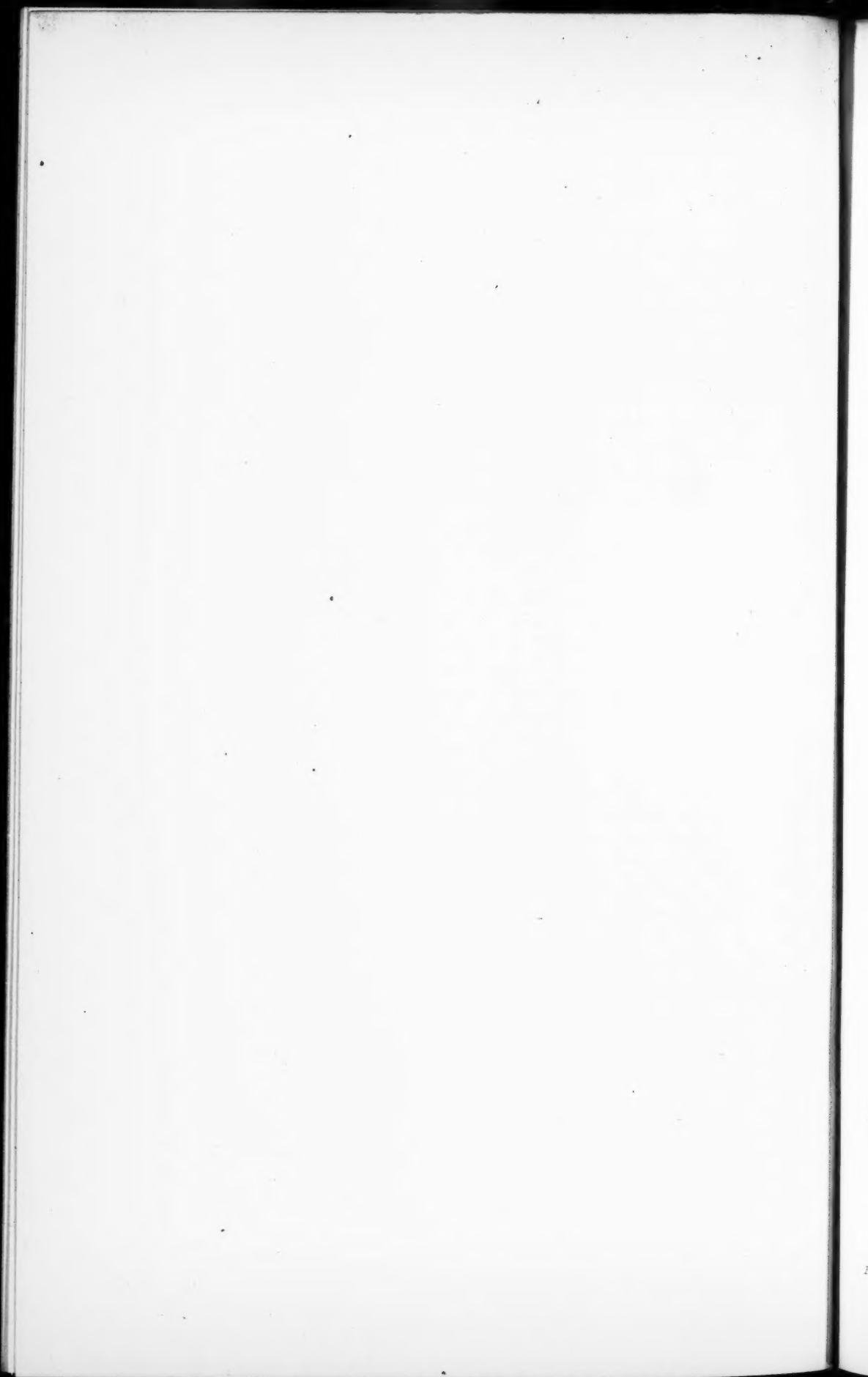


Fig. 1.

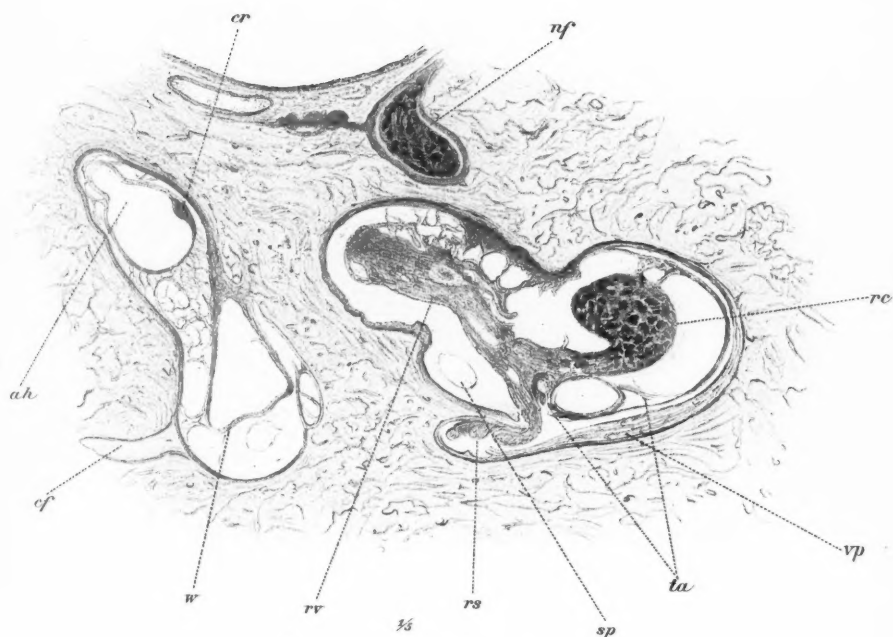


Fig. 3.

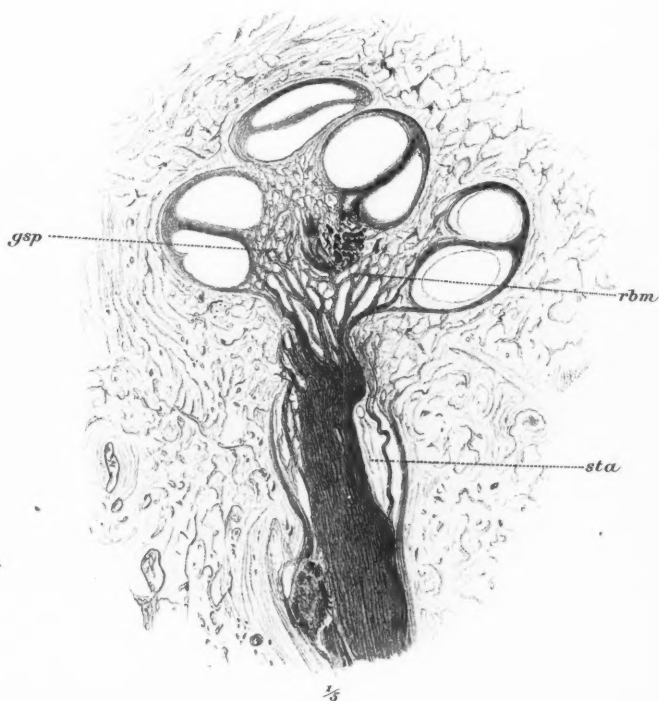
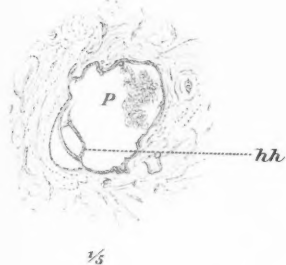


Fig. 12.



Fig. 2.



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Fig. 4.

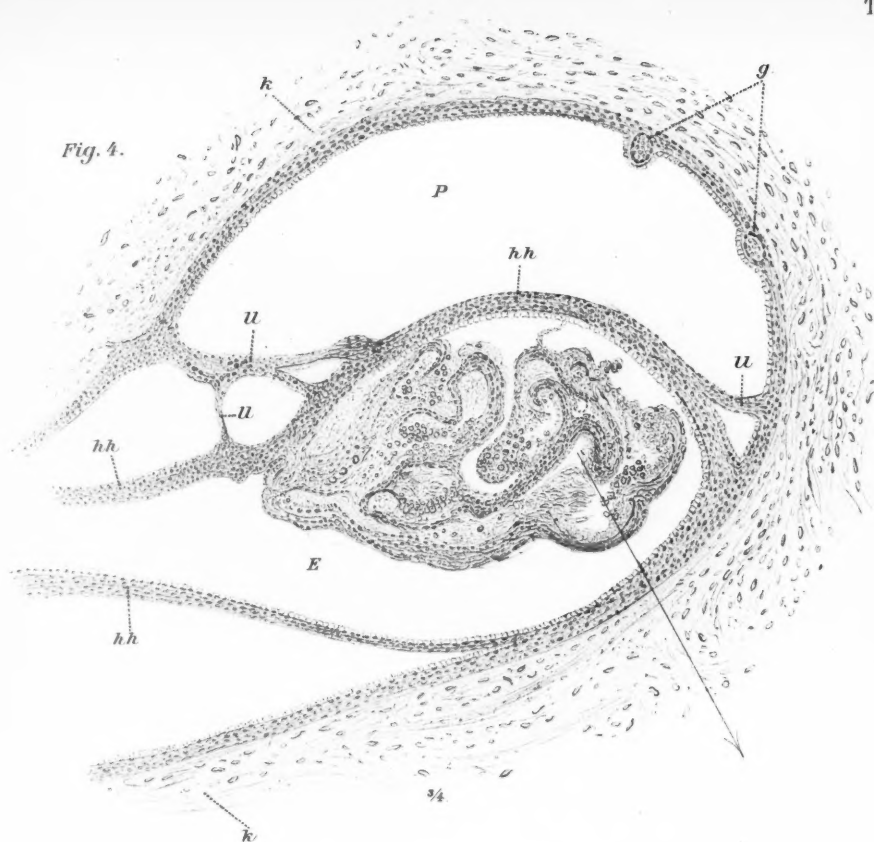


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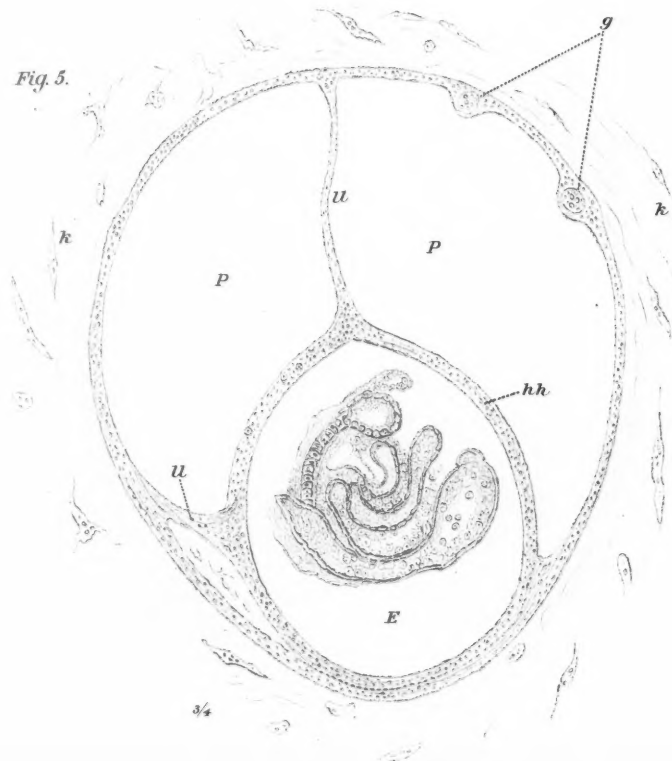
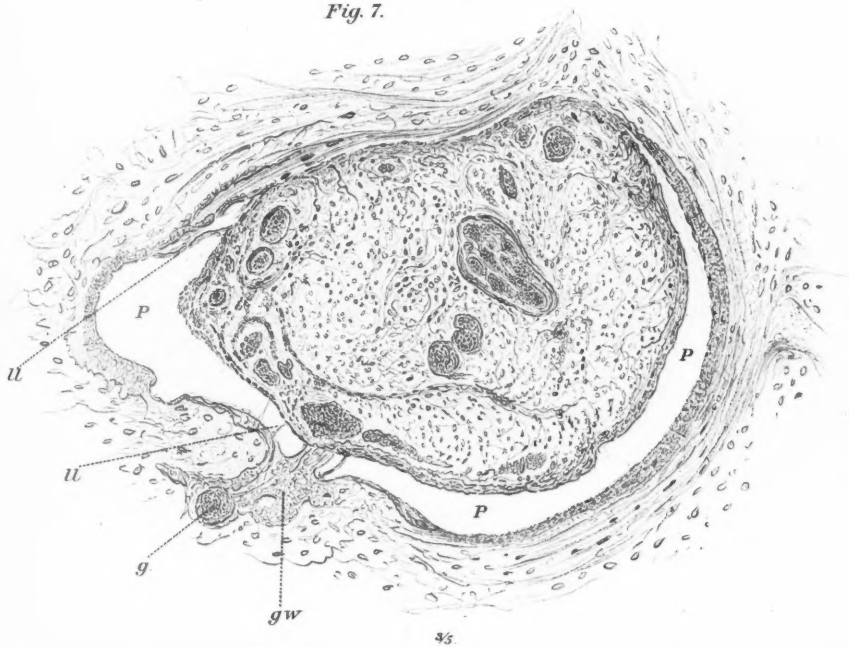




Fig. 6.



Fig. 7.



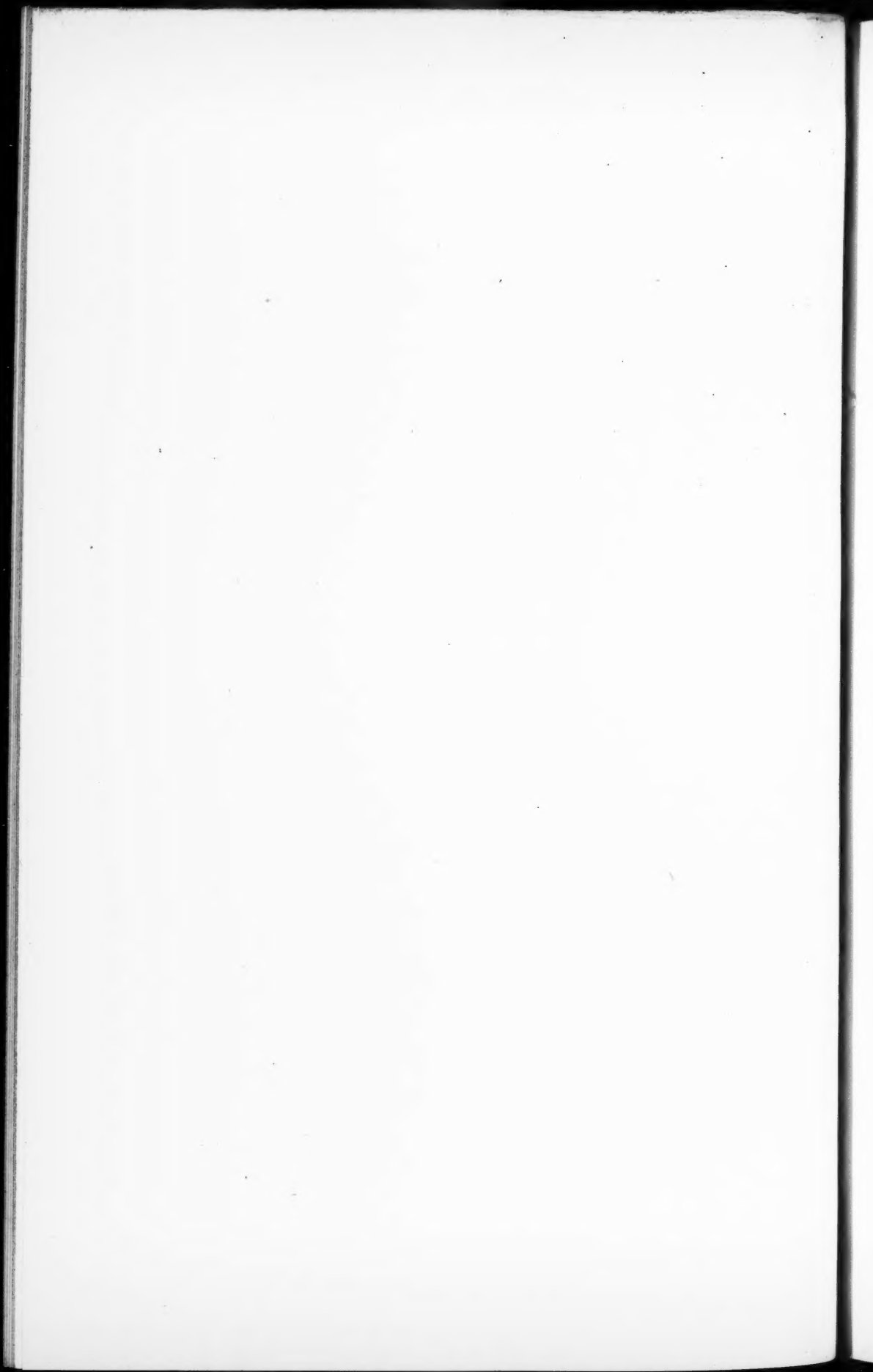


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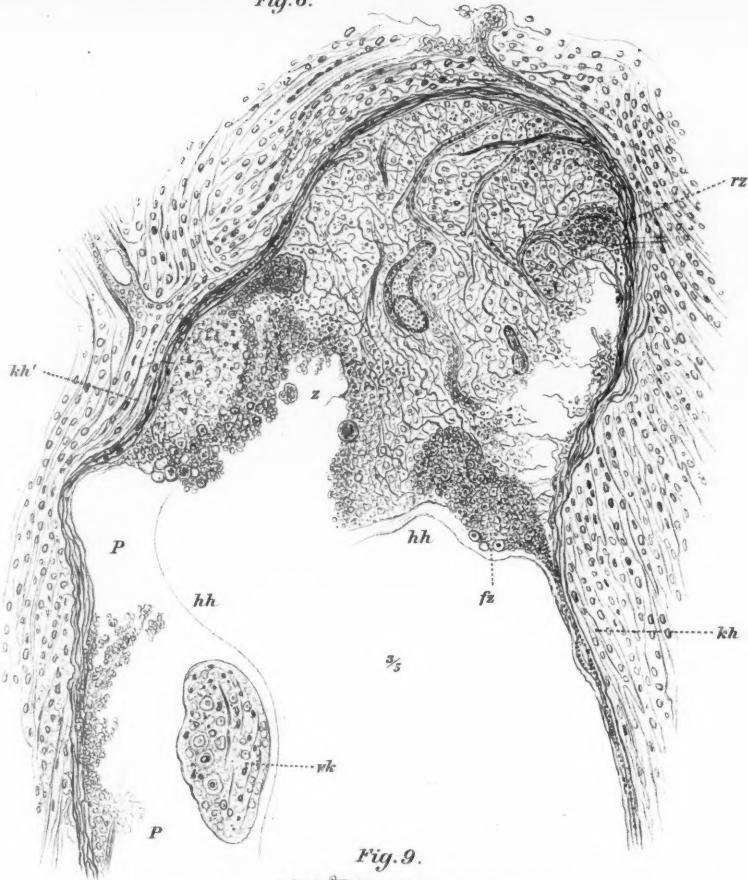


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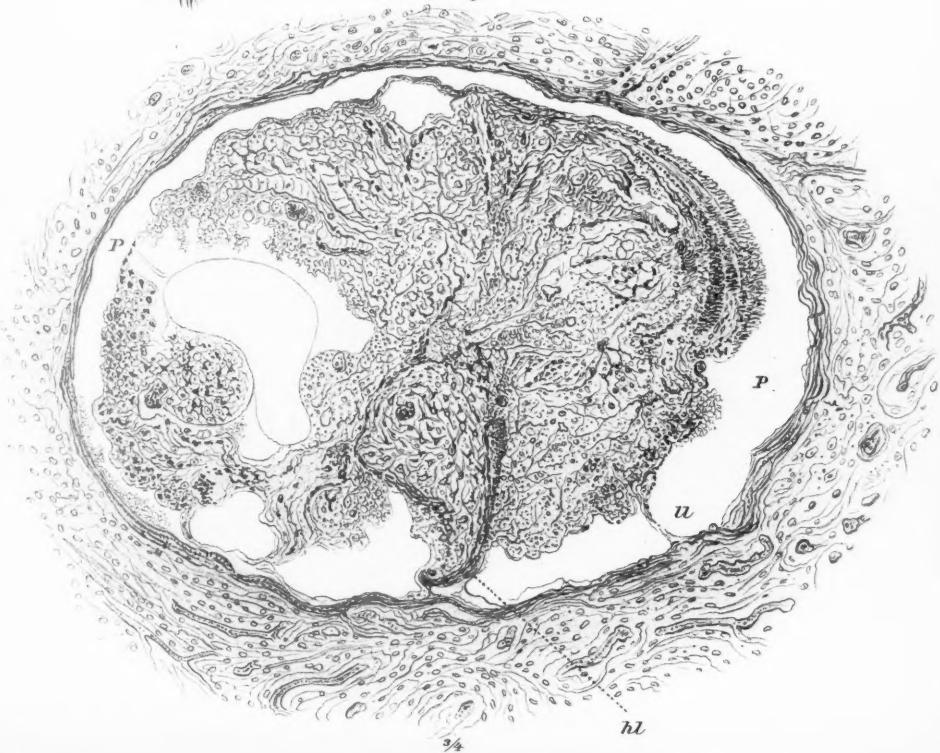


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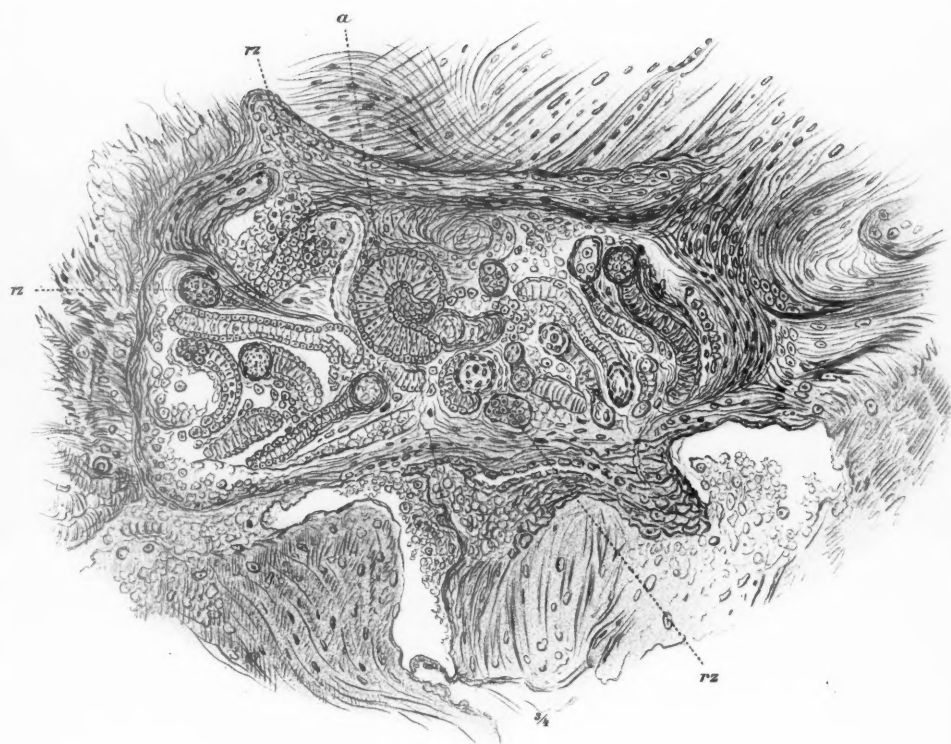
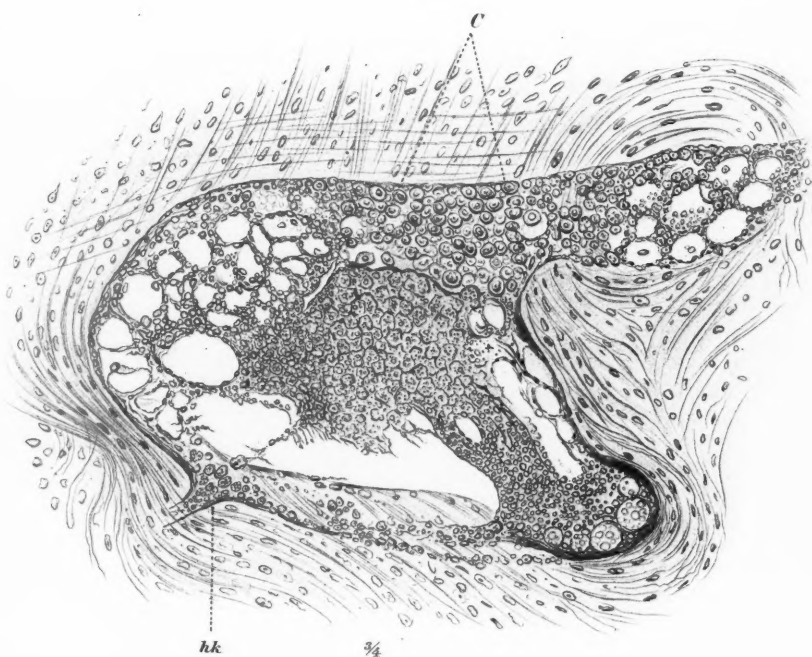


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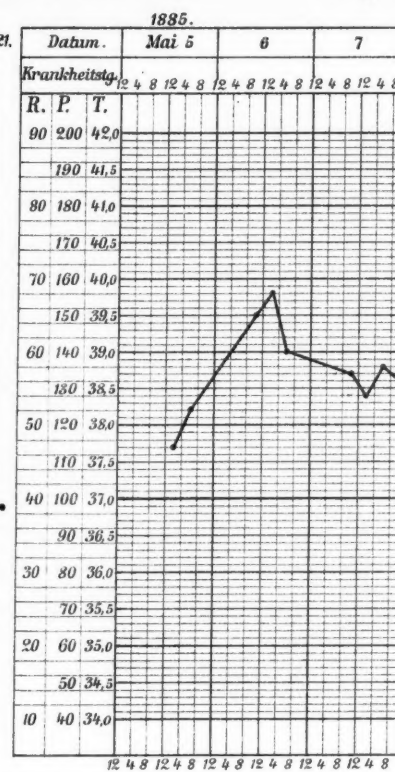


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Diagnose: *Otitis media acuta purulenta sinistra.*

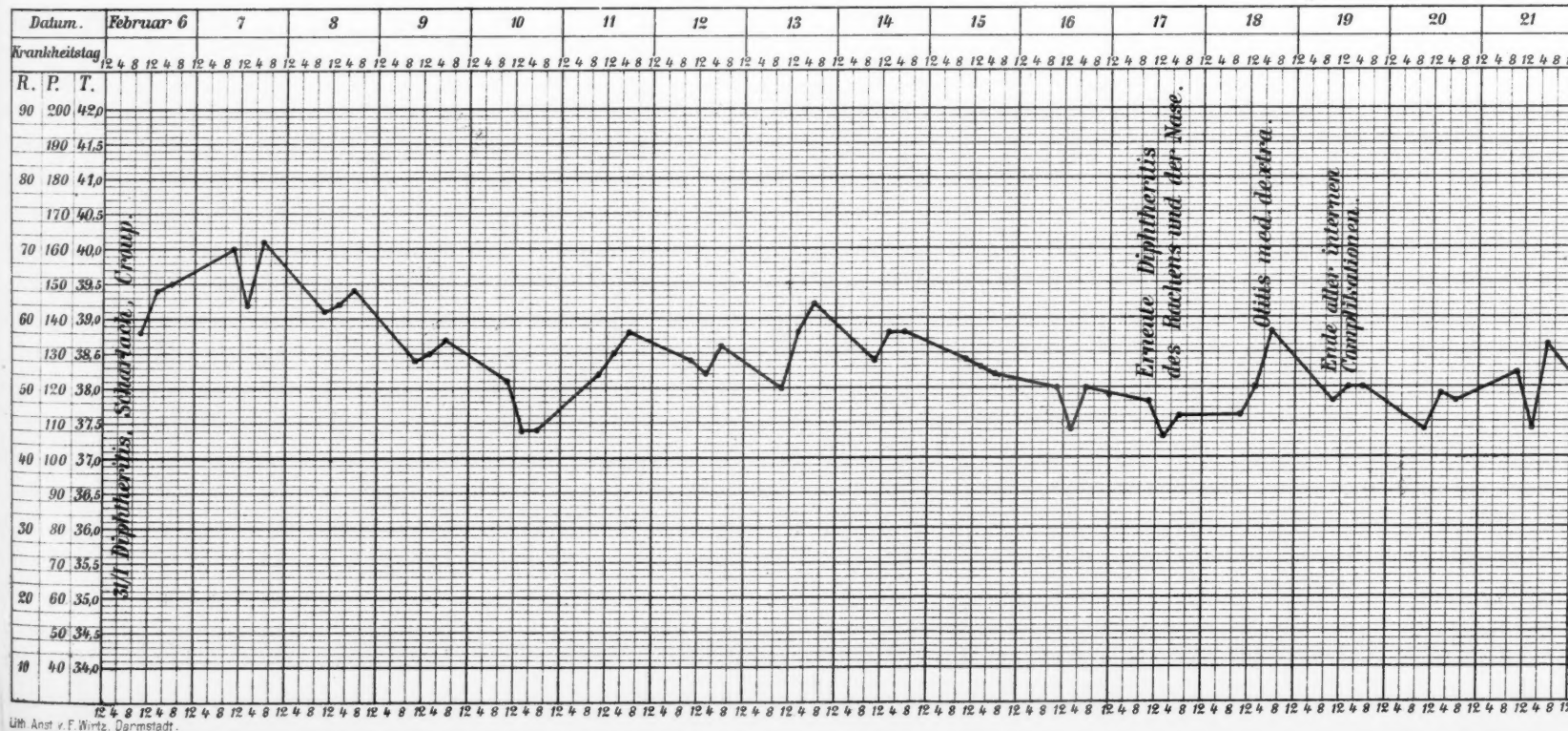
II. Name: Wl.

Diagnose:



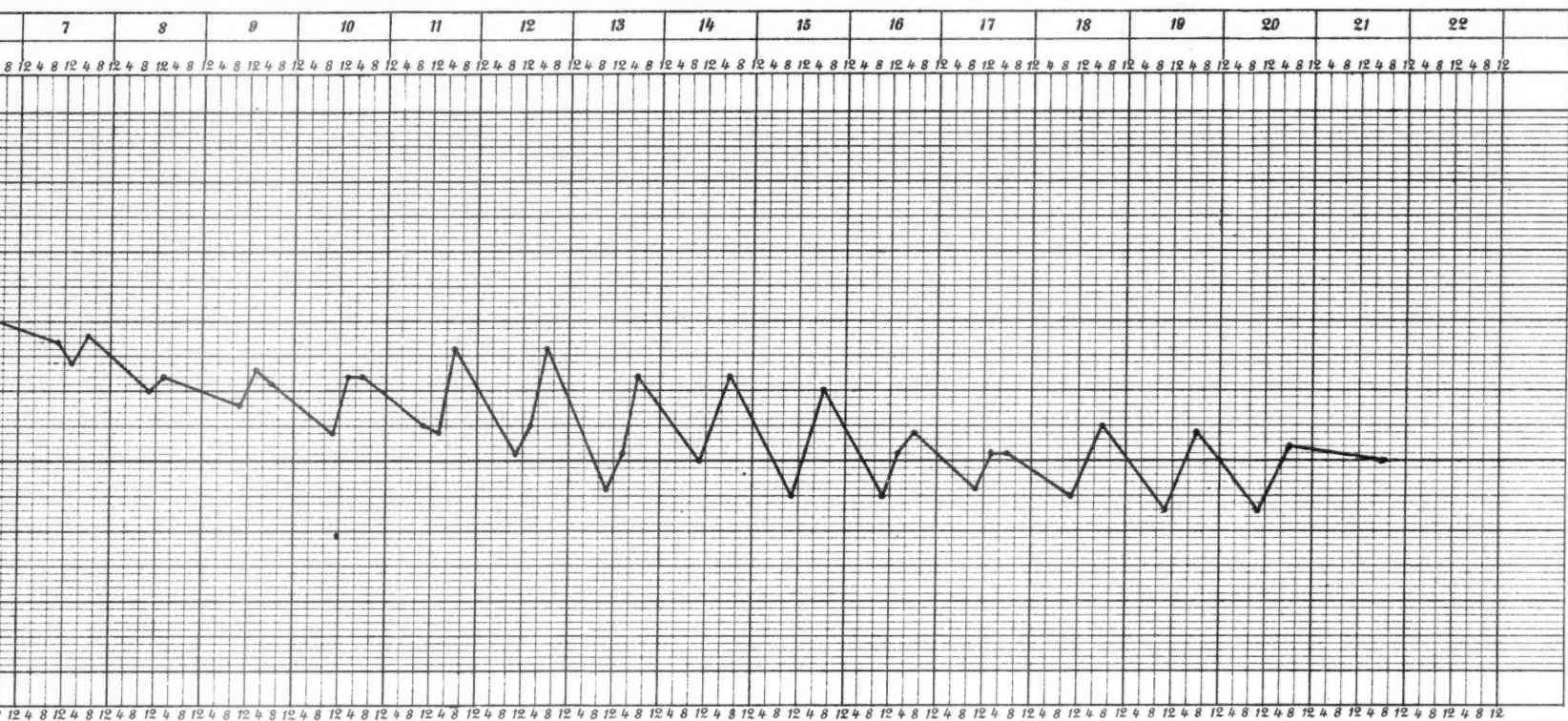
III. Name: M.

Diagnose: *Otitis media diph*

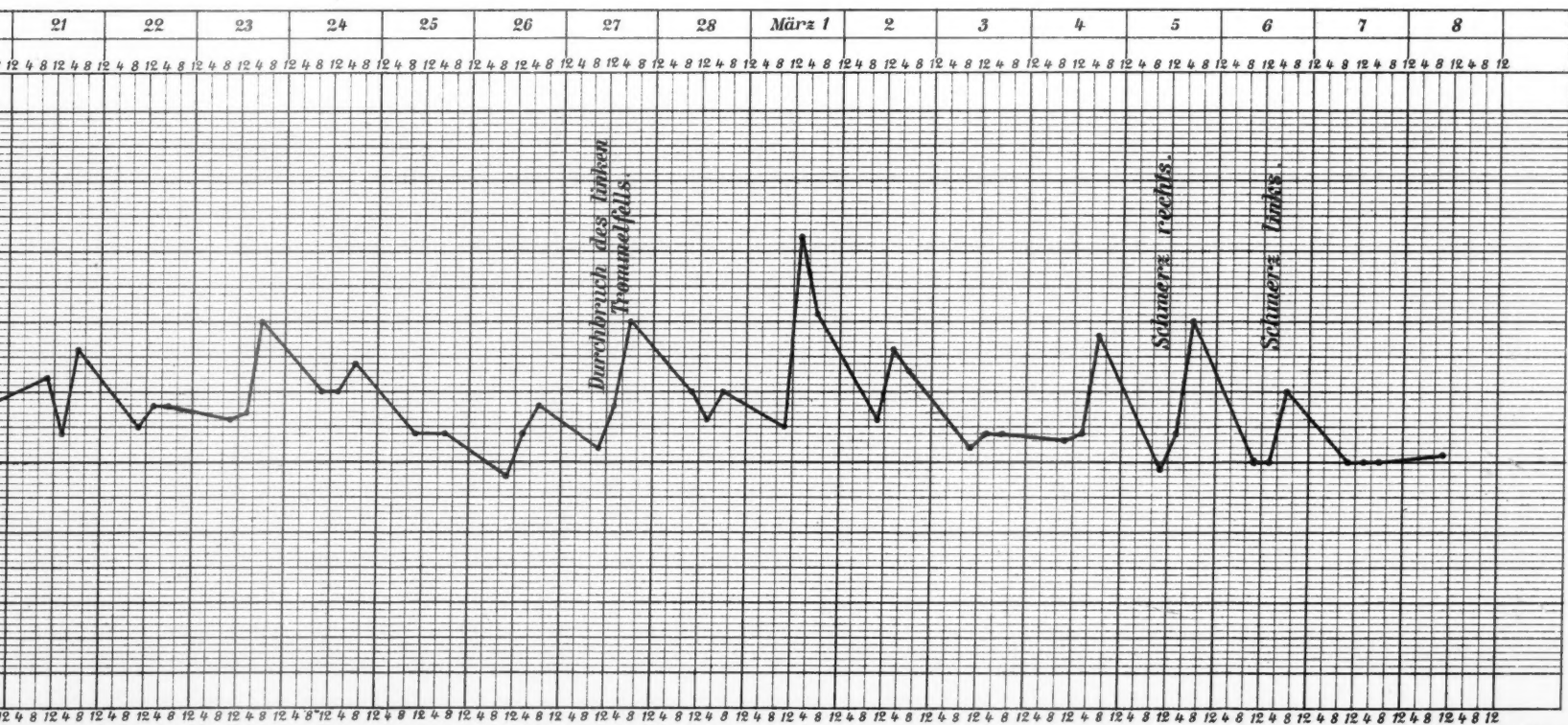


Diagnose: Doppelseitige acute eitrige Trommelhöhlenentzündung, rechts ohne, links mit Perforation.

Tab. VI-VIII.

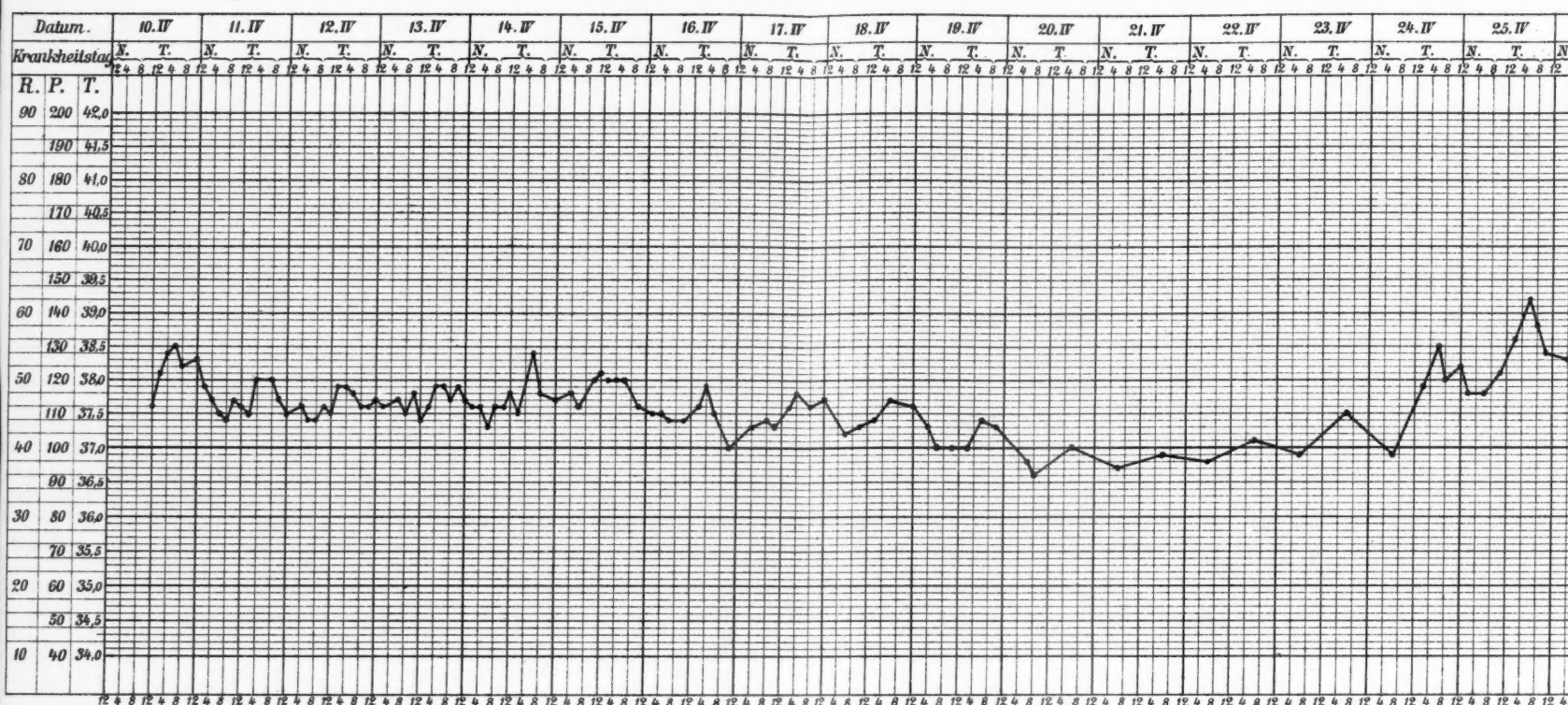


a diphtherica duplex.

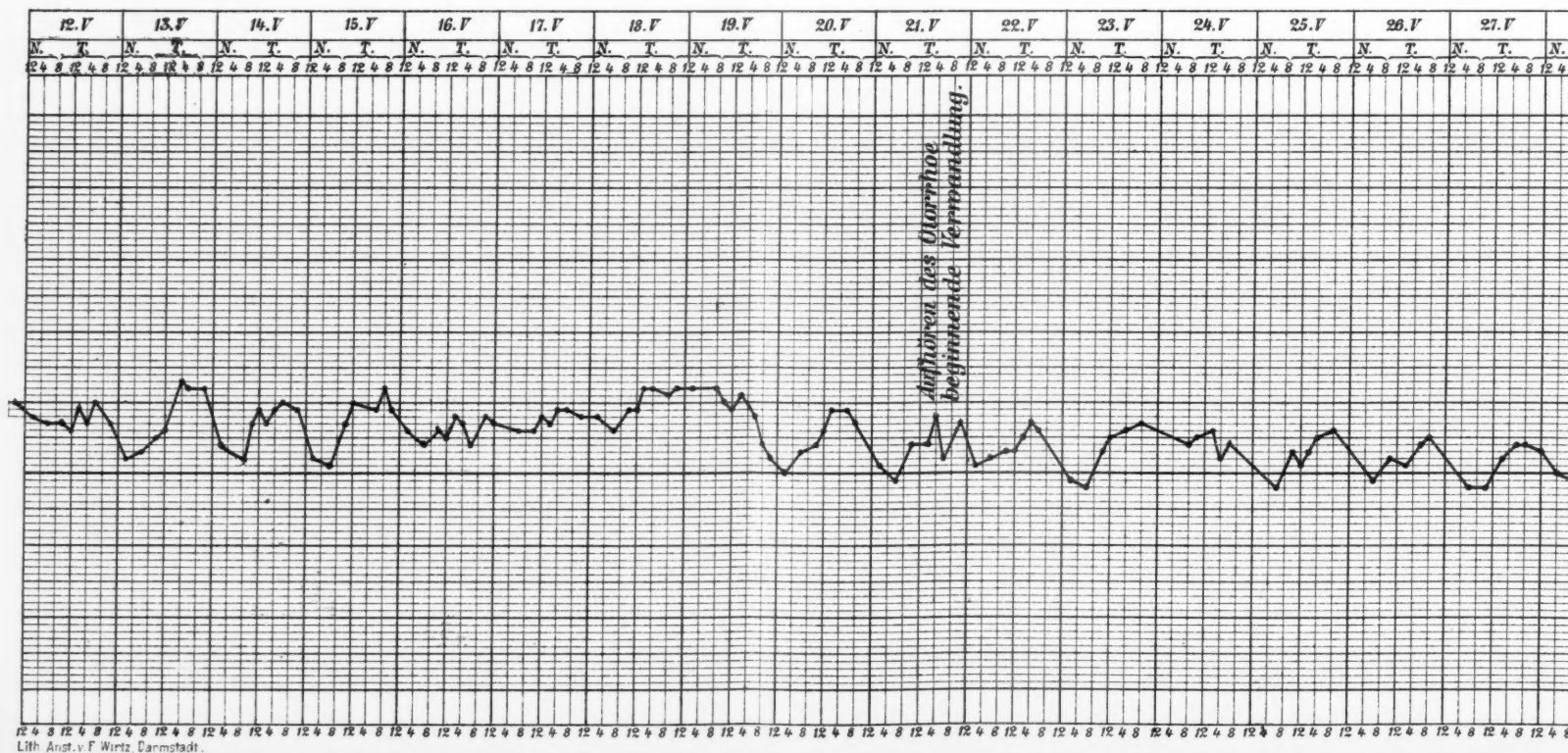


IV. Name: U.

Diagnose: Diphtherie.



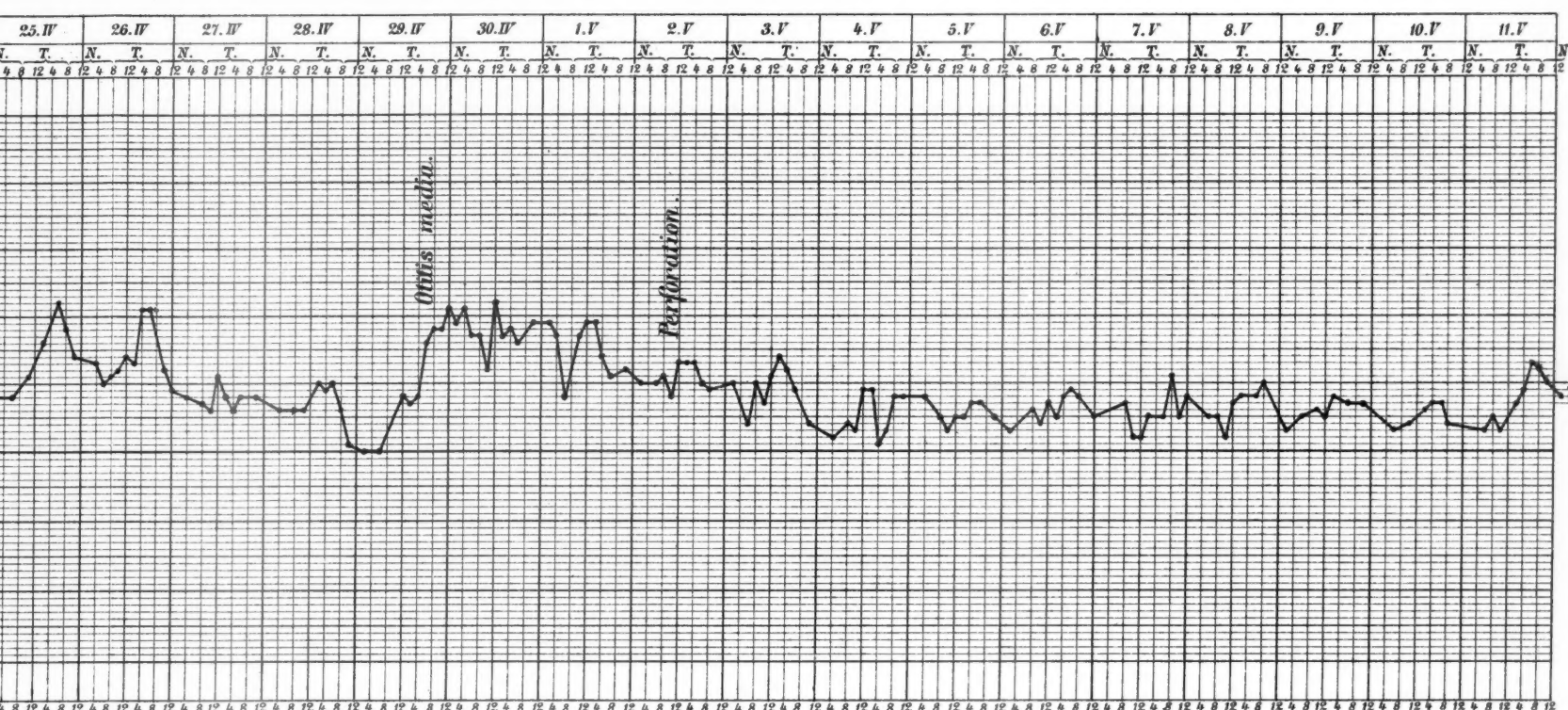
Otitis diphtherica dextra.



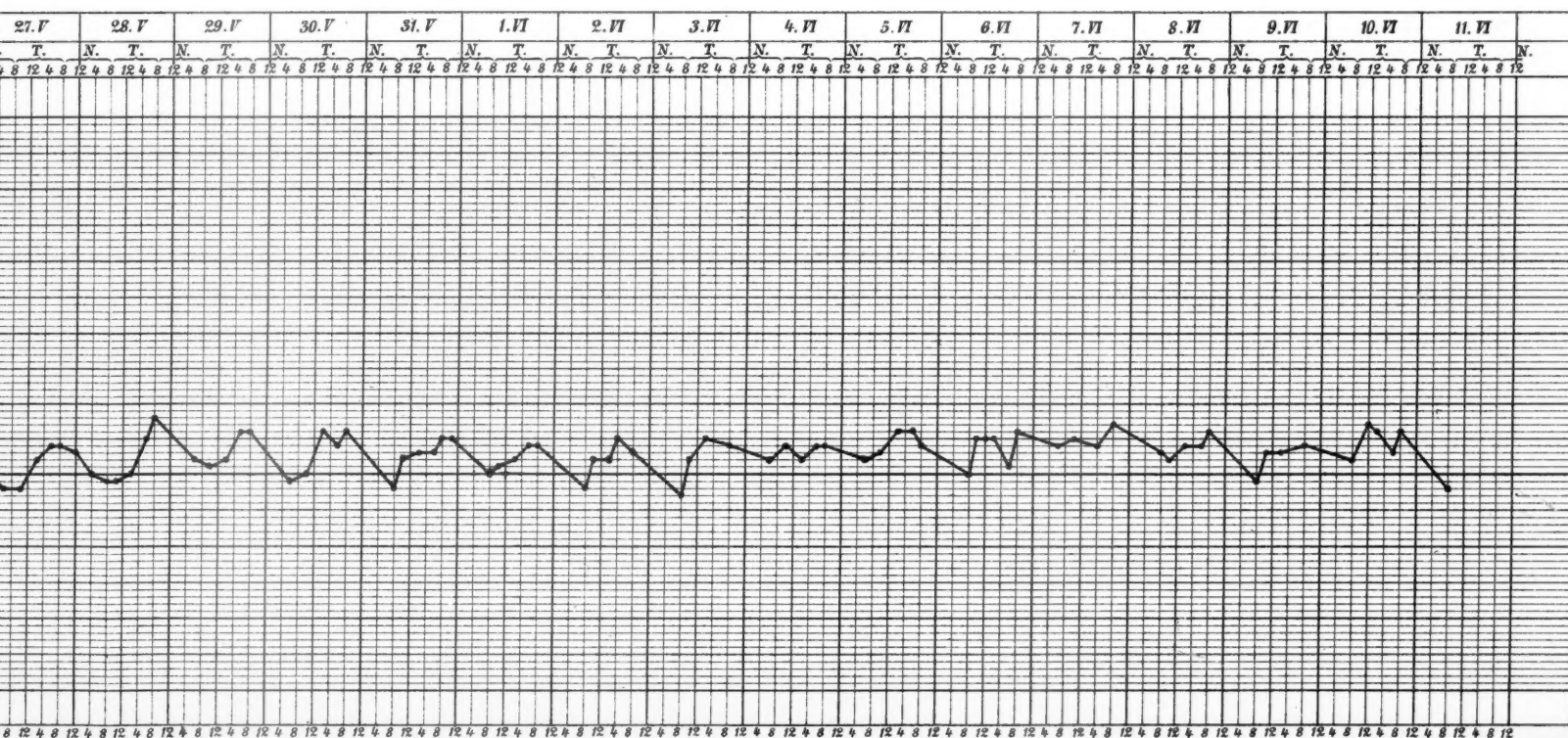
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Otitis diphtherica dextra.

Tab. IX-XI.



Otitis diphtherica dextra.



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The editors and publishers of the ARCHIVES beg to offer some suggestions to authors who propose to favor them with their contributions.

1. As original communications the ARCHIVES can accept only such papers as have never been printed nor are intended to be printed in other journals. If a preliminary communication on the subject of a paper has been published, the author is requested to state this in the letter accompanying his manuscript. It is understood that contributors to these ARCHIVES and editors of other periodicals will make no abstracts of the original papers published in this journal without giving it due credit for the same.

2. Authors will receive gratuitously twenty-five reprints of their articles. If a greater number is desired,—notice of which should be given at the head of the manuscript,—only the additional cost of presswork and paper will be charged to the author.

3. In preparing manuscript for the compositor it is requested that the following rules be adhered to :

a. Write on one side of the paper only.

b. Write without breaks, *i. e.* do not begin a new sentence on a new line. When you want to begin a new line or paragraph at a given word, place before it in your MS. the sign ¶.

c. Draw a line along the margin of such paragraphs as should be printed in smaller type—for instance, all that is clinical history in reports of cases, etc.

d. Words to be printed in *italics*, should be underscored once, in SMALL CAPITALS twice, in LARGE CAPITALS three times.

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